REMARKS

Claims 1-12 are pending in the application. The Examiner objected to Claims 1, 2, 6, 7, 9 and 10 based on informalities. The Examiner rejected Claim 10 under 35 U.S.C. §112, second paragraph, as being indefinite. The Examiner rejected Claims 6-12 under 35 U.S.C. §102(e) as being anticipated by Choi et al. (U.S. Patent 6,724,740). The Examiner rejected Claims 1-5 under 35 U.S.C. §103(a) as being unpatentable over Choi et al. in view of Tiedemann, Jr. et al. (U.S. Patent 6,396,867).

Please amend Claims 1, 2, 6, 7, 9 and 10 as set forth herein. No new matter has been added.

Regarding the objections to Claims 1, 2, 6, 7, 9 and 10, these claims have been amended according to the recommendations of the Examiner.

Based on at least the foregoing, withdrawal of the objections to Claims 1, 2, 6, 7, 9 and 10 is respectfully requested.

Regarding the rejection of Claim 10 under §112, second paragraph, the Examiner states that the claim is indefinite. Claim 10 has been amended as set forth above to address the minor issues raised by the Examiner.

Based on at least the foregoing, withdrawal of the rejection of Claim 10 under §112 is respectfully requested.

Regarding the rejections of Claims 6-12 under §102(e) and Claims 1-5 under §103(a), both of these rejections rely on Choi et al. as the main reference. Choi et al. is assigned to Samsung Electronics Co., Ltd. The earliest filing date of Choi et al. that the Examiner can rely on is August 11, 1998. The priority dates of the present application are March 23, 1998 and April 14, 1998, both of which predate Choi et al. Certified English language translations of the priority document, KPA No. 1998/10394 and 1998/14276, are attached hereto, thus removing Choi et al. as a reference.

Based on at least the foregoing, withdrawal of the rejections of Claims 6-12 under §102(e) and Claims 1-5 under §103(a) is respectfully requested.

Furthermore, regarding the rejections of Claims 1-5 under §103(a), please note that the Choi et al. reference is owned by Samsung Electronics Co., and qualifies as prior art only under §102(e). As such, under 35 U.S.C. §103(c), Choi et al. does not qualify as prior art since subject matter developed by another person, which qualifies as prior art only under one or more of subsections (e), (f), and (g) of section 102, shall not preclude patentability where the subject matter and the claimed invention were, at the time the claimed invention was made, owned by the same person or subject to an obligation of assignment to the same person.

Based on at least the foregoing, withdrawal of the rejections of Claims 1-5 under §103(a) is respectfully requested.

Independent Claims 1, 6 and 9 are believed to be in condition for allowance. Without conceding the patentability per se of dependent Claims 2-5, 7, 8 and 10-12, these are likewise believed to be allowable by virtue of their dependence on their respective amended independent claims. Accordingly, reconsideration and withdrawal of the rejections of dependent Claims 2-5, 7, 8 and 10-12 is respectfully requested.

Accordingly, all of the claims pending in the Application, namely, Claims 1-12, are believed to be in condition for allowance. Should the Examiner believe that a telephone conference or personal interview would facilitate resolution of any remaining matters, the Examiner may contact Applicants' attorney at the number given below.

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CERTIFICATE OF TRANSLATION

As a below named translator, I hereby declare that my residence and citizenship are as stated below next to my name and I hereby certify that I am conversant with both the English and Korean languages and the document enclosed herewith is a true English translation of the Korean patent application No. 1998-14276 filed on April 14, 1998.

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[TITLE OF THE INVENTION]

METHOD FOR CONTROLLING POWER OF COMMON CHANNEL FOR REVERSE LINK IN CDMA COMMUNICATION SYSTEM

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIGs. 1 through 3 are diagrams illustrating signals communicated between a base station and a mobile station during power control for a reverse link common channel according to the present invention;

FIGs. 4 and 5 are flow diagrams illustrating the operations of the base station and the mobile station, respectively, when a message is transmitted by power controlling the common channel of the reverse link according to a first embodiment of the present invention;

FIGs. 6 and 7 are flow diagrams illustrating the operations of the base station and the mobile station, respectively, when a message is transmitted by power controlling the common channel of the reverse link according to a second embodiment of the present invention;

FIGs. 8 and 9 are flow diagrams illustrating the operations of the base station and the mobile station, respectively, when a message is transmitted by power controlling the common channel of the reverse link according to a third embodiment of the present invention;

FIGs. 10 and 11 are flow diagrams illustrating the operations of the base station and the mobile station, respectively, when a message is transmitted by power controlling the common channel of the reverse link according to a fourth embodiment of the present invention;

FIGs. 12 and 13 are diagrams illustrating in detail an initial power control when a message is transmitted by power controlling the common channel of the reverse link as illustrated in FIG. 1;

FIGs. 14 and 15 are diagrams illustrating in detail an initial power control when a message is transmitted by power controlling the common channel of the reverse link as illustrated in FIG. 2 or 3;

FIG. 16 is a diagram illustrating another common channel for the reverse link in the case where a channel transmitter of the base station sends a power control signal via a common power control channel;

FIGs. 17 and 18 are exemplary diagrams illustrating a method for the mobile station to receive the power control signal from the base station via the common power control channel;

FIG. 19 is an exemplary diagram showing a structure of a response message of the base station using the common power control channel when the mobile station request the base station for a designated common channel for the reverse link; and

FIGs. 20 through 23 are diagrams illustrating a method for transmitting a message according to embodiments of the present invention.

[DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS]

[OBJECT OF THE INVENTION]

[RELATED FIELD AND PRIOR ART OF THE INVENTION]

The present invention relates to a power control method in a code division multiple access (CDMA) communication system, and in particular, to a method for controlling power of a common channel for the reverse link.

CDMA mobile communication systems have been developed since they start from the related art mobile communication standard primarily providing the voice service and are now expected to be performed in accordance with the IMT-

2000 (International Mobile Telecommunication-200) standard which can provide not only the voice service but also a high speed packet service. The IMP-2000 standard supports a high quality voice service, a moving picture service, an internet search service, etc. The communication paths between a mobile station and a base station in the CDMA mobile communication system are divided into two paths: one is a forward link for transmitting a signal from the base station to the mobile station and the other is a reverse link for transmitting a signal from the mobile station to the base station.

Conventionally, the CDMA mobile communication system performs no power control for the reverse link common channel so that it takes long time for the mobile station to access the communication system via the reverse link common channel and the mobile station can transmit a short message only. In addition, the mobile station accesses the system without knowing an appropriate initial system access power, exerting great influence on the system.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a method for controlling power of a common channel for the reverse link in a CDMA communication system.

To achieve the above object, there is provided a method for controlling power of a common channel for a reverse link between a base station and a mobile station in a code division multiple access (CDMA) communication system including the steps of: (1) at the base station, performing a power control by transmitting a power control signal to the mobile station at a time which the base station detects a specified signal rather than a message received from the mobile station via the common channel for the reverse link; and (2) when the power control is performed to an appropriate extent, transmitting at the mobile station a message to the base station via the common channel for the reverse link while the base station is performing the power control.

[CONSTRUCTION AND OPERATION OF THE INVENTION]

Preferred embodiments of the present invention will become described in detail referring to the attached drawings. It is to be noted that like reference numerals denote the same components in the drawings, and a detailed description of generally known function and structure of the present invention will be avoided lest it should obscure the subject matter of the present invention. Following examples are exemplary only and are not to be considered as limiting the scope of the invention.

FIGs. 1 through 3 are diagrams illustrating signals communicated between a base station and a mobile station during power control of a reverse link common channel according to the present invention. More specially, FIG. 1 shows the case in which all the reverse link common channels are power controlled, and FIGs. 3 and 4 show the cases in which designated ones of the reverse link common channels are power controlled.

Referring to FIG. 1, the base station transmits a power control signal to the mobile station, which in turn transmits a preamble to the base station. As shown in the figure, the mobile station does not transmit a message but the preamble to the base station via the reverse link common channel to perform the initial power control until it receives from the base station a command to transmit the message or until a lapse of predetermined time. There are two methods for determining the time for the mobile station to transmit the message to the base station.

In a first method, the base station determines the time for the motile station to send the message via the reverse link common channel. The base station measures the intensity of the preamble signal which is transmitted by the mobile station for purpose of the initial power control and sends a power control signal to the mobile station. The mobile station then controls the transmission power according to the received power control signal and sending the controlled transmission power to the base station. The base station determines whether or not the intensity of the signal transferred from the mobile station is appropriate. If the intensity of the signal is determined to be appropriate, the base station sends to the mobile station a command to transmit the message.

In a second method, the initial power control is performed for a predetermined period of time. When the base station measures the intensity of the preamble signal transferred from the mobile station and transmits the power control signal to the mobile station, for the predetermined period of time, the mobile station controls the transmission power according to the received power control signal and then transmits the message to the base station at a specific point of time.

On the other hand, the preamble transmission is a procedure to transmit messages acknowledged between the mobile station and the system when there exist parameters to be matched between the mobile station and the system or when either one of the mobile station or the system intends to know the state of the other party. For example, the messages known between the mobile station and the system may be all "0"s or "1"s.

In the case where the reverse link common channel is power controlled to transmit the message, the mobile station discontinues sending the message if the power of the power control signal received from the base station is considerably lower than a threshold value or the state of the forward link channel is not good, and resumes the signal communication in a little time.

Referring to FIG. 2, the base station request the base station for a designated common channel via the reverse link common channel as well as sends information concerning the amount of data to transmit via the designated common channel. Here, the designated common channel refers to a specific channel which can be exclusively used by a specific user, among the common channels used in common by all the users. For designation of the common channels, several codes are separately provided in addition to the codes for the common channels, and one of the codes is assigned to one user for a while. Alternatively, for designation of the common channels, one of the common channels is assigned to one user for a while, who requires a designated channel, and the other users cannot use this channel in the meantime.

Upon receiving the request for the designated channel and the amount of transmission data, the base station determines whether to assign the designated channel to the mobile station in consideration of the usage of the data to be transmitted by the mobile station requesting the designated channel, the amount of transmission data and the present condition, sending a response signal to the mobile station using the forward link common channel. The base station transmits a power control signal in a predetermined period of time after the response signal is transmitted. The mobile station then controls the transmission power between the base station and the mobile station by sending the preamble signal to the base station until a message transmission command is received from the base station, via the designated channel based on the contents of the response signal, or for a predetermined period of time. Upon reception of the message transmission command from the base station or after a lapse of the predetermined time, the mobile station sends to the base station the intended message via the designated channel for the reverse link. Even at this time, the base station continues to send the power control command so that the power control is performed without ceasing while the mobile station sends the message.

Referring to FIG. 3, the base station transmits to the mobile station through the forward link common channel a command to send the message using the designated channel for the reverse link and information necessary for data transmission. After a lapse of a predetermined time, the base station sends a power control signal to the mobile station. At this time, the mobile station controls the transmission power between the base station and the mobile station by sending a preamble signal solely until a message transmission command is received from the base station or after a predetermined period of time. Upon reception of the message transmission command from the base station or after a lapse of the predetermined time, the mobile station sends to the base station the intended message via the designated channel for the reverse link. Even at this time, the base station continues to send the power control command so that the power control is performed without ceasing while the mobile station sends the message.

FIGs. 4 and 5 are flow diagrams illustrating operations of the base station and the mobile station when a message is transmitted by power controlling the reverse link common channel according to a first embodiment of the present invention. In this embodiment, the mobile station and the base station performs the initial power control for a predefined time T_W, and then sends an actual message.

Referring to FIG. 4, in step A1, the mobile station sends a preamble signal of the lowest level to the base station via the common channel for the reverse link. The mobile station checks in step A2 on whether a power control signal is received from the base station via the common channel for the forward link. If not receiving the power control signal, the mobile station increases the level of the preamble signal by a predefined amount in step A3 on the judgement that the base station has failed to sense the preamble signal due to its lowness in power. The flow of the process returns to step A2. Upon reception of the power control signal from the base station, the mobile station sends in step A4 controls the level of the preamble signal according to the received power control signal and sends the power controlled preamble signal to the base station. After sending the power controlled preamble signal, the mobiles station proceeds to step A5 to check on whether a predefined time TW has elapsed. When the predefined time TW has not elapsed yet, the mobile station compares the power of the received power control signal with a threshold value, in step A6. If a second power control signal is received from the base station, the mobile station goes back to step A4 in which it controls the level of the preamble signal according to the received power control signal and sends the power controlled preamble signal to the base station. If the second power control signal is not received from the base station, the mobile station sends in step A7 the preamble signal, maintaining the previous power level. The mobile station increases a count value CNT by one, in step A8. The count value CNT represents how many times the mobile station has sent the preamble signal in the previous power level. When the count value CNT is equal to or higher than a threshold value in step A9, the mobile station releases the reverse link common channel in step A11. However, when the count value CNT is lower than the threshold value, the procedure returns to the step A5.

If the predefined time TW has elapsed in step A5, the mobile station continuously receives, in step A10, the power control signal from the base station and simultaneously sends an intended message to the base station via the reverse link common channel by controlling the transmission power according to the received power control signal. After transmission of the message, the reverse link common channel is released in step A11.

As described above, the mobile station sends the preamble signal to the base station via the reverse link common channel prior to actually sending the message in step A10, and the base station then sends the power control signal to the mobile station. In this manner, the initial power control is performed to control the power of the reverse link common channel to a desired extent. The purpose of the initial power control is to enable the mobile station to stably send the first several frames of the intended message.

Referring to FIG. 5, the base station checks in step B1 whether the preamble signal is received from the mobile station. Upon detection of the preamble signal from the mobile station, the base station measures the intensity of the received preamble signal in step B2, and then sends a power control signal to the mobile station according to the measurement in step B3. Thereafter, the base station determines in step B4 whether the predefined time T_W has elapsed, to return to the step B1 when the predefined time TW has not elapsed. After a lapse of the predefined time TW, the mobile station receives the message sent from the mobile station in step B5 and then releases the corresponding common channel in step B6. In the meantime, the base station sends the power control signal to the mobile station even while receiving the message from the mobile station, so as to enable the mobile station to control the transmission power according to the power control command.

FIGs. 6 and 7 are flow charts illustrating operations of the base station and the mobile station when a message is transmitted by power controlling the common channel for the reverse link according to a second embodiment of the present invention. Compared to the first embodiment shown in FIGs. 4 and 5, the embodiment of FIGs. 6 and 7 has a difference in that the base station informs the mobile station of a message transmission time while the initial power control is performed between the base station and the mobile station.

Referring to FIG. 6, the procedure is analogous to that of FIG. 4 with an exception that in step C5, which corresponds to step A5 of FIG. 4. the mobile station checks whether the message transmission signal has been received from the base station, in order to determine whether to finish the initial power control and actually send the intended message.

Referring to FIG. 7, the procedure is analogous to that of FIG. 5 with an exception in steps D4 and D5 which replace the step B4 of FIG. 5. In step D4, the base station compares the intensity (i.e., receiving power) of the preamble signal received from the mobile station with a threshold value. If the intensity of the preamble signal is within the permissible range, the base station proceeds to step D5 to send the message transmission command to the mobile station. Of course, even at this moment, the base station sends the power control signal to the mobile station.

FIGs. 8 and 9 are flow charts illustrating operations of the base station and the mobile station when a message is transmitted by power controlling the designated common channel for the reverse link according to a third embodiment of the present invention. The third embodiment is similar to the first embodiment in that the mobile station and the base station exchanges an actual message after performing the initial power control for the predefined time T_W, with an exception that since the power control is performed for the designated common channel only, which requires the mobile station to request the common channel and the base station to assign the channel precedently.

Referring to FIG. 8, in step E1, the mobile station sends a channel request signal to the base station in order to use the designated channel. The mobile station can send information about a message to send, together with the channel request signal. The base station then analyzes the information sent from the mobile station to determine whether to use the designated common channel for the reverse link. When it is intended to use the designated reverse link common channel, the mobile station sends a channel assignment command and associated channel assignment information as a response signal via the forward link common channel (See steps F1-F3 and F11 of FIG. 9). The mobile station then receives the response signal in step E2, and determines in step E3 whether the response signal corresponds to an acknowledge signal ACK or a negative acknowledge signal NAK. Upon reception of the ACK signal which represents that the base station permits the mobile station to use the designated common channel for the reverse link, the mobile station performs the initial power control for a predefined time T_W and then actually sends a message. Since the procedure in steps E4-E9 is equal to that in steps A1-A6 of FIG. 4, the associated description will be avoided. After sending the message in step E9, the mobile station releases the designated common channel in step E10.

Referring to FIG. 9, in step F1, the base station receives from the mobile station the channel request signal and the information about the message that the mobile station intends to send. In step F2, the base station analyzes the received information to determine whether or not to permit the mobile station to use the designated common channel for the reverse link. To permit the mobile station to use the designated common channel, the base station sends in step F3 a channel assignment command and associated information required for the channel assignment to the mobile station via the common channel for the forward link. Not to permit the mobile station to use the designated common channel, the base station sends the NAK signal to the mobile station in step F11. On the other hand, after sending the ACK signal in step F3, the base station waits for a predefined time T_G in step F4, taking into consideration the time for which the ACK signal reaches the mobile station. The procedures of performing the initial power control and receiving the actual message in steps F5-F9 which will be performed after a lapse of the time T_G, are equal to those in steps B1-B5 of FIG. 5 and thus will not be described in detail. After receiving the message in step F9, the base station releases the designated common channel in step F10.

FIGs. 10 and 11 are flow charts illustrating operations of the base station and the mobile station when a message is transmitted by power controlling the designated common channel for the reverse link according to a fourth embodiment of the present invention. This embodiment is similar to the second embodiment in that the base station informs the mobile station of the time to transmit a message during the initial power control between the base station and the mobile station, with an exception that since the power control is performed for the designated common channel only, which requires the mobile station to request the common channel and the base station to assign the channel precedently.

Referring to FIG. 10, in step G1, the mobile station sends a channel request message to the base station in order to use the designated common channel. The mobile station can send information about the message to send, together with the channel request message. The base station then analyzes the information sent from the mobile station to determine whether to use the designated reverse link common channel. When it is intended to use the designated reverse link common channel, the mobile station sends a channel assignment command and associated channel assignment information as a response signal via the forward link common channel (See steps H-H3 and H12 of FIG. 11). The mobile station then receives the response signal in step G2, and determines is step G3 whether the response signal corresponds to an acknowledge signal ACK or a negative acknowledge signal NAK. Upon reception of the ACK signal, the mobile station performs the initial power control and then sends the intended message at a predetermined time or upon reception of a message transmission command from the base station, as shown in steps G4-G13. Since procedures in steps G4-G13 are equal to those in steps C1-C10 of FIG. 6, the detailed descriptions will be avoided. After sending the message in step G13, the mobile station releases the designated common channel in step G14.

Referring to FIG. 11, in step H1, the base station receives from the mobile station the channel request signal and the information about the message that the mobile station intends to send. In step H2, the base station analyzes the received information to determine whether or not to permit the mobile station to use the designated common channel for the reverse link. To permit the mobile station to use the designated common channel, the base station sends in step H3 the channel assignment command (i.e., ACK signal) and associated channel assignment information to the mobile station via the forward link common channel. On the other hand, not to permit the mobile station to use the designated common channel, the base station sends the NAK signal to the mobile station in step H11. In the meantime, after sending the ACK signal in step H3, the base station waits for the predefined time T_G in step H4, taking into consideration the time for which the ACK signal reaches the mobile station. The procedures of performing the initial power control and receiving the actual message in steps H5-H9 which will be performed after a lapse of the time T_G, are equal to those in steps D1-D6 of FIG. 7 and will not be described in detail. After receiving the message in step H10, the base station releases the designated common channel in step H11.

FIGs. 12 and 13 are diagrams for explaining the procedures of the initial power control when the a message is transmitted by power controlling the common channel for the reverse link as illustrated in FIG. 1. FIGs. 14 and 15 are diagrams for explaining the procedures of the initial power control when a message is transmitted by power controlling the designated common channel for the reverse link as illustrated in FIG. 2 or 3. In the figures, the signals transmitted through the channels are delivered over time, and the common channels for the reverse link have the transmission power represented by the level of the transmission signals in order to illustrate that the mobile station performs the initial power control as transmitting a preamble. FIGs. 12 and 14 correspond to the case where a pilot channel is not used for the reverse link, while FIGs. 13 and 15 correspond to the case where the pilot channel is used for the reverse link.

Referring to FIG. 12, the base station sends a power control signal to the mobile station, and the mobile station sends a message MSG after sending the preamble for a predetermined time, in order to use the power controlled common channel for the reverse link. The initial power control is performed between the base station and the mobile station while the mobile station transmits the preamble. The intensity of the first preamble transmitted by the mobile station is calculated according to Equation 1 or 2 given by:

[Equation 1]

Initial Transmission Power = (1st Constant) - (Total Reception Power)

[Equation 2]

Initial Transmission Power = (2nd Constant) - (Reception power of Pilot Signal from Connected Base Station)

These values should be low enough to minimize interference on the system. Hence, the base station sends a power-up command until the preamble signal sent from the mobile station is acquired during the power control process (For example, step B3 of FIG. 5, step A3 of FIG. 4, step D3 of FIG. 7 and step C3 of FIG. 6). The base station compares the acquired signal from the mobile station with a signal received through another channel and thereby sends both the power-up command and the power-down command. A duration T_W of the initial power control is predetermined or determined by the base station at the time when it is judged that the base station has controlled the power appropriately by acquiring the preamble, so as to stop sending the preamble.

On the other hand, in the case where the pilot channel is not used for the reverse link, as shown in FIG. 12, the preamble signal is not sent until the message transmission via the common channel for the reverse link. Instead, a signal transmitted via the pilot channel during the initial power control is used as a preamble signal. Although the pilot channel is typically used for the receiver to estimate the state of the channel and synchronize between the receiver and the transmitter, it is utilized in this embodiment for the initial power control.

Referring to FIG. 13, the signal transmitted via the pilot channel during the initial power control serves as the preamble signal, and after completion of the initial power control, serves as a pilot signal. The intensity of the signal serving as the pilot signal can be changed to differ from that of the signal serving as the preamble signal. When the preamble signal is transmitted via the pilot channel in this manner, the common channel for the reverse link maintains a standby state without generating other signals for a predefined time TW or until the base station sends a message transmission command, as illustrated. This is the same with the designated common channel of FIG. 15 which will be described later.

Referring to FIGs. 14 and 15, the mobile station grants the mobile station to use the designated common channel for the reverse link, and sends a response signal having the channel designation information via the common channel for the forward link. Considering the transmission delay of the response signal and the reception delay of the mobile station, the mobile waits for a predefined time T_G (in step F4 of FIG. 9 and step H4 of FIG. 11) and sends a power control signal. In order to use the power controlled common channel for the reverse link, the mobile station sends the preamble signal for a predetermined time and then sending a message. The initial power control is performed between the base station and the mobile station while the mobile station transmits the preamble signal via the designated common channel for the reverse link as illustrated in FIG. 14, or for the time T_W the pilot signal serving as the preamble signal is transmitted via the pilot channel.

The power control methods as described in FIGs. 1-15 may be realized using a conventional channel or a separate channel, which is the common power control channel as disclosed in the Patent Application No. 10394 filed on March 23, 1998.

FIGs. 16 and 17 illustrate two exemplary methods for the mobile station to receive a power control signal transmitted from the base station via a common power control channel.

FIG. 16 corresponds to the case where the base station has a channel transmitter which does not transmit the power control signal inserted into the common channel (e.g., traffic channel or control channel) for the forward link but has the common power control channel.

FIG. 17 corresponds to the case where the mobile station has a single channel receiver for receiving both a message transmitted via another channel for the forward link and a power control signal transmitted via the common power control channel. The channel for the forward link is, not limited to, a traffic channel or a control channel but may be a traffic channel in the following descriptions expediently. In order to use the common power control channel, the base station sends, to the mobile station, a Walsh code number for the common power control channel to be used and information about the position of the power control command (hereinafter, referred to as "common power control channel information"). Mobile stations (for example, user k, ..., user j) can know, from the common power control channel information, their own Walsh code W_i and the positions where the power control signals for themselves are located.

The channel receiver in each mobile station receives a message transmitted via the forward common control channel using the assigned Walsh codes W_j ...W_k, and after a lapse of a predefined time, receiving the power control signal using the Walsh code W_i assigned for the common power control channel. After reception of the power control signal, the channel receiver receives the message on the forward common channel using the previously used Walsh codes W_j ...W_k. The mobile station has one channel receiver only and cannot receive the message transmitted via the traffic channel while it receives the power control signal, thereby obtaining the result of puncturing the power control signal into the forward common control channel. When the power control signal is added to the traffic channel as in the prior art, one separate Walsh code should be continuously assigned for transmission of the power control signal, even when there is no message to be transmitted via the traffic channel. On the contrary, in the embodiment, using the common power control channel makes it possible to release the assigned Walsh code W_j ...W_k when there is no message to transmit and receive the power control signal at a predefined position using the Walsh code W_i, which enables more users to utilize the traffic channel simultaneously.

FIG. 18 corresponds to the case where the mobile station has two channel receivers for receiving a message via another channel for the forward link and a power control signal via a common power control channel. The channel for the forward link is, not limited to, a traffic channel or a control channel but may be a traffic channel in the following descriptions expediently. The difference from the case of FIG. 16 relies in that the two channel receivers make it possible to receive the message transferred via the traffic channel during reception of the power control signal. That is,

FIG. 17 corresponds to the case where the mobile station has a single channel receiver for receiving both a message transmitted via another channel for the forward link and a power control signal transmitted via the common power control channel. This prevents the channel degradation which may occur in the case where the symbols on the forward common control channel are partially punctured to insert therein the power control signals, thereby enhancing a quality of data reception.

FIG. 19 illustrates a structure of a message the base station sends using a common power control channel in response to the request of the mobile station for a designated common channel for the reverse link. The message may be one of the response signals shown in FIGs. 14 and 15. As illustrated, the message consists of a message body having specific contents (undecided), a designation flag, channel designation information representing the designated common channel for the reverse link, a power control flag representing whether to control the power, preamble start time information representing a start time of the preamble, a Walsh number representing a Walsh code number used for the common power control channel, and a slot index representing the locations of the power control commands. When the common power control channel is not used, the Walsh number and the slot index are excluded from the message.

The designation flag represents whether the designated common channel is available or not. The channel designation information is (identification) information about the designated channel when the designated channel is available. The channel designation information may use a long code. The successive power control flag and preamble are also valid only when the designated channel is used. The power control flag may designate the fixed position of the power control signal or the pattern of the power control signal whose position varies. Further, when the mobile station sends a message by power controlling the common channel for the reverse link, the preamble signal is used for the initial power control. Although the time for starting transmission of the preamble signal can be set after a lapse of a predetermined time succeeding a message for assigning the designated reverse link common channel, the base station can designate the time to the preamble start time information.

FIGs. 20 through 23 show several methods for transmitting a message according to the present invention. More specifically, there are shown several examples of controlling the power during a standby state after transmission of the message. Reference symbol PA denote a preamble and reference symbol MSG denotes a message to be transmitted.

FIG. 20 shows a method of transmitting an intended message by message blocks of a predetermined size. After sending one message block and waiting for an ACK signal from the base station, the mobile station transmits the next message block upon reception of the ACK signal, or resends the message block upon reception of the NAK signal or upon failure to receive the ACK signal for a predefined time. The mobile station does not control the power during a standby state after sending one message block. Therefore, before sending the next message block or resending the transmitted message block, the mobile station should send the preamble for the initial power control. In the figure, (a) indicates a message transmission without using the pilot channel for the reverse link, and (b) indicates a message transmission using the pilot channel for the reverse link. The case where the pilot channel is used for the reverse link is already described with reference to FIGs. 12 through 16.

FIG. 21 shows a method for transmitting an intended message by message blocks of a predetermined size in a similar manner to FIG. 20. The mobile station sends one message block of the predetermined size and waits for the ACK signal from the base station. Upon receiving the ACK signal, the mobile station sends the next message block, or upon failure to receive the ACK signal, the mobile station resends the message block. A difference from the procedure of FIG. 20 relies in that the mobile station performs a power control during a standby state after sending one message block to the base station. This makes it unnecessary for the mobile station to transmit a preamble signal in order to perform the initial power control in sending the next message block or resending the previous message block. In the figure, (a) indicates a message transmission without using the pilot channel for the reverse link, and (b) indicates a message transmission using the pilot channel for the reverse link.

FIG. 22 shows a method of waiting for an ACK signal from the base station after sending the whole intended message at a time. The mobile station does not perform the power control during a standby state waiting for the ACK signa. Therefore, when the mobile station receives an NAK signal or no ACK signal within a predefined time, it sends the preamble signal for the initial power control prior to retransmitting the message. In the figure, (a) indicates a message transmission without using the pilot channel for the reverse link, and (b) indicates a message transmission using the pilot channel for the reverse link.

FIG. 23 shows a method of divisionally transmitting an intended message into several message blocks of a predetermined size and receiving ACK signals for the respective message block transmitted. When the mobile station receives an NAK signal or no ACK signal within a predefined time, it has to resend the message block in one of the following two methods: the first method is to resend only the message block for which the NAK signal is received or for which the ACK signal is not received within the predefined time; and the second method is to resend all the message blocks succeeding the message block for which the

NAK signal is received or for which the ACK signal is not received within the predetermined time. For example, it is assumed that the ACK signal for a third message block is not received for the predefined time or the NAK signal for the third message block is received during transmission of a fifth message block. In this case, the first method retransmits only the third message block after transmitting the fifth message block, and the second method retransmits the third to fifth message blocks after transmitting the fifth message block. In the figure, (a) indicates a message transmission without using the pilot channel for the reverse link, and (b) indicates a message transmission using the pilot channel for the reverse link.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

[EFFECT OF THE INVENTION]

The present invention shortens the time required for an access to the communication system and enables transmission of a long burst message due to a power control using the common channel for the reverse link. Further, the initial power for accessing the system can be controlled appropriately, thereby minimizing the influence on the system.

[PATENT CLAIM(S)]

1. A method for controlling power of a common channel for a reverse link between a base station and a mobile station in a code division multiple access (CDMA) communication system, comprising the steps of:

(1) at the base station, performing a power control by transmitting a power control signal to the mobile station at a time which the base station detects a specified signal rather than a message received from the mobile station via the common channel for the reverse link; and

(2) when the power control is performed to an appropriate extent, transmitting at the mobile station a message to the base station via the common channel for the reverse link while the base station is performing the power control.

2. The method as claimed in claim 1, wherein in step (1), the specific signal the base station receives from the mobile station is a preamble signal.

3. The method as claimed in claim 2, wherein the step (1) comprises the steps of:

(1-1) at the mobile station, sending the preamble signal with the lowest power level and then checking on whether the power control signal is received from the base station;

(1-2) when the power control signal is not received in step (1-1), sending a preamble signal with an increased power level and then checking on whether the power control signal is received from the base station; and

(1-3) when the power control signal is received in step (1-1) or (1-2), controlling the level of the preamble signal according to the power control signal and sending the power-controlled preamble signal to the base station;

wherein the base station checks on whether the preamble signal is received from the mobile station and, upon reception of the preamble signal, measures the intensity of the preamble signal, sending the power control signal to the mobile station.

4. The method as claimed in claim 1, wherein the step (1) includes a procedure of performing the initial power control.

5. The method as claimed in claim 4, wherein an initial power control is performed for a predefined period of time.

6. The method as claimed in claim 4, wherein the initial power control is performed while the base station receives the preamble signal from the mobile station.

7. The method as claimed in claim 5 or 6, wherein for a part of the

time the initial power control is performed, the base station adds a transmission power-up command to the power control signal whenever it sends the power control signal.

8. The method as claimed in claim 4, wherein the initial power control is performed right until the base station sends a message transmission command to the mobile station and the mobile station receives the message transmission command after the base station measures the intensity of the preamble signal and determines that the intensity of the preamble signal is within a permissible range.

9. The method as claimed in claim 1, wherein in step (1), the power control signal is transmitted via a common power control channel.

10. The method as claimed in any one of claims 2 to 9, wherein the preamble signal is a pilot channel signal for the reverse link.

11. The method as claimed in any one of claims 1 to 9, wherein in step (2), the mobile station transmits the message by message blocks of a predetermined size and, after sending one message block to the base station, performs the power control without ceasing while it is waiting for a response from the base station.

12. The method as claimed in claim 11, wherein the preamble signal is a pilot channel signal of the reverse link.

13. The method as claimed in any one of claims 1 to 12, wherein in step (2), the mobile station transmits the message by message blocks of a predetermined size and, after sending one message block to the base station, ceases the power control while it waits for a response from the base station, then returning to step (1) for sending a second message block or resending the first message block.

14. The method as claimed in claim 13, wherein the preamble signal is a pilot channel signal of the reverse link.

15. The method as claimed in any one of claims 1 to 9, wherein in step (2), after sending the whole message to the base station at a time, the mobile station ceases the power control while it waits for a response from the base station and, upon receiving a negative acknowledgment signal or not receiving an acknowledgment signal within a predefined time, returns to step (1) for resending the message.

16. The method as claimed in claim 15, wherein the preamble signal is a pilot channel signal of the reverse link.

17. A method of controlling power of a designated common channel for a reverse link between a base station and a mobile station in a CDMA communication system, comprising the steps of:

(1) at the base station, assigning the designated common channel for the reverse link to the mobile station;

(2) after a lapse of predefined time the base station assigns the designated common channel to the mobile station, sending a power control signal at the base station and sending at the mobile station a specific signal rather than a message via the designated common channel, thereby performing an initial power control; and

(3) after completion of the initial power control, sending at the mobile station the message to the base station while the base station continues the power control.

18. The method as claimed in claim 17, wherein in step (2), the specific signal rather than the message the mobile station transmits is a preamble signal.

19. The method as claimed in claim 18, wherein the step (2) comprises the steps of:

(1-1) at the mobile station, sending the preamble signal with the lowest power level and then checking on whether the power control signal is received from the base station;

(1-2) when the power control signal is not received in step (1-1), sending a preamble signal with an increased power level and then checking on whether the power control signal is received from the base station; and

(1-3) when the power control signal is received, controlling the level of the preamble signal according to the power control signal and sending the power-controlled preamble signal to the base station;

wherein the base station checks on whether the preamble signal is received from the mobile station and, upon reception of the preamble signal, measures the intensity of the preamble signal, sending the power control signal to the mobile station.

20. The method as claimed in claim 19, wherein the initial power control is performed for a predefined period of time.

21. The method as claimed in claim 19, wherein the initial power control is performed right until the base station sends a message transmission command to the mobile station and the mobile station receives the message transmission command after the base station measures the intensity of the preamble signal and determines that the intensity of the preamble signal is within a permissible range.

22. The method as claimed in claim 17, wherein in step (1), the

power control signal is transmitted via a common power control channel.

23. The method as claimed in any one of claims 18 to 22, wherein in step (1), the base station sends a specific response signal to the mobile station to designate the common channel for the reverse link,

wherein the response signal comprises a designate flag representing whether the designated common channel is available, channel designation information representing the designated common channel for the reverse link, a power control flag representing whether the power control is performed, preamble start time information representing a start time of the preamble signal, an Walsh number informing an Walsh code number used in the common power control channel, and a slot index for designating a position of the power control signal.

24. The method as claimed in any one of claims 18 to 22, wherein the preamble signal is a pilot channel signal of the reverse link.

25. The method as claimed in any one of claims 17 to 22, wherein in step (2), the mobile station transmits the message by message blocks of a predetermined size and, after sending one message block to the base station, performs the power control without ceasing while it is waiting for a response from the base station.

26. The method as claimed in claim 25, wherein the preamble signal is a pilot channel signal of the reverse link.

27. The method as claimed in any one of claims 17 to 22, wherein in step (2), the mobile station transmits the message by message blocks of a predetermined size and, after sending one message block to the base station, ceases the power control while it waits for a response from the base station, then returning to step (1) for sending a second message block or resending the first message block.

28. The method as claimed in claim 27, wherein the preamble signal is a pilot channel signal of the reverse link.

29. The method as claimed in any one of claims 17 to 22, wherein in step (2), after sending the whole message to the base station at a time, the mobile station ceases the power control while it waits for a response from the base station and, upon receiving a negative acknowledgment signal or not receiving an acknowledgment signal within a predefined time, returns to step (1) for resending the message.

30. The method as claimed in claim 29, wherein the preamble signal is a pilot channel signal of the reverse link.

31. The method as claimed in claim 17, wherein the step (1) comprises the steps of:

at the mobile station., requesting the base station for the designated common channel for the reverse link; and

assigning at the base station the designated common channel to the mobile station in response to the channel request of the mobile station.

32. The method as claimed in claim 17, wherein in step (1), the designated channel is assigned using a channel use command the base station sends to the mobile station one-sidedly.

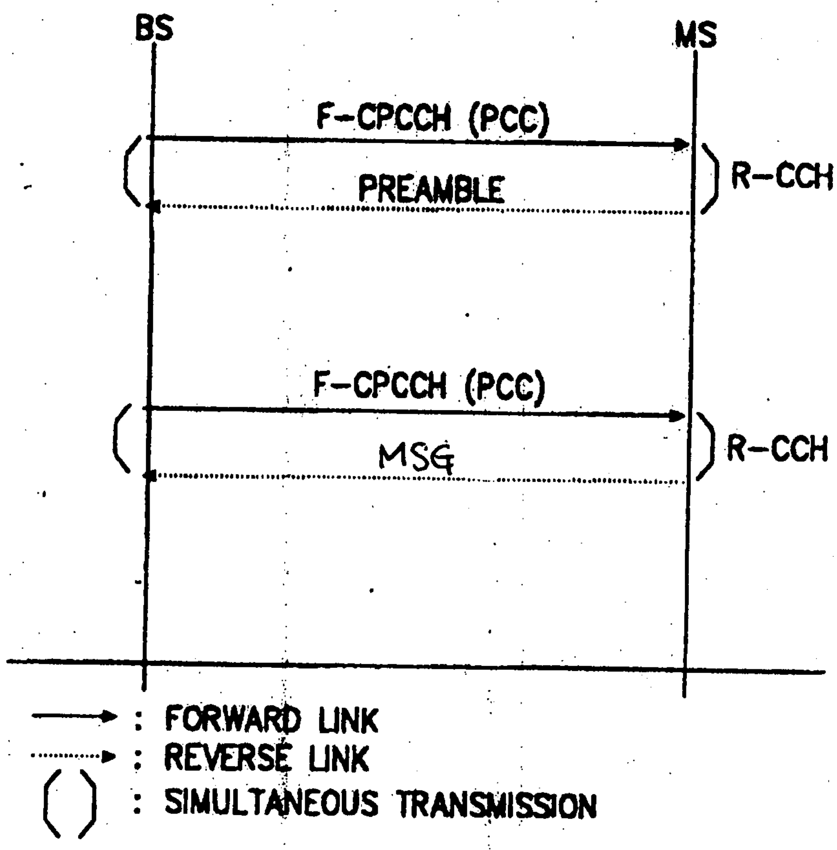
[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

There is provided a method for controlling power of a common channel for a reverse link between a base station and a mobile station in a code division multiple access (CDMA) communication system including the steps of: (1) at the base station, performing a power control by transmitting a power control signal to the mobile station at a time which the base station detects a specified signal rather than a message received from the mobile station via the common channel for the reverse link; and (2) when the power control is performed to an appropriate extent, transmitting at the mobile station a message to the base station via the common channel for the reverse link while the base station is performing the power control.

[REPRESENTATIVE FIGURE]

FIG. 2



BS
MS
F-CPCCH (PCC)
PREAMBLE
R-CCH
F-CPCCH (PCC)
MSG
R-CCH
: FORWARD LINK
: REVERSE LINK
( ) : SIMULTANEOUS TRANSMISSION

FIG. 1

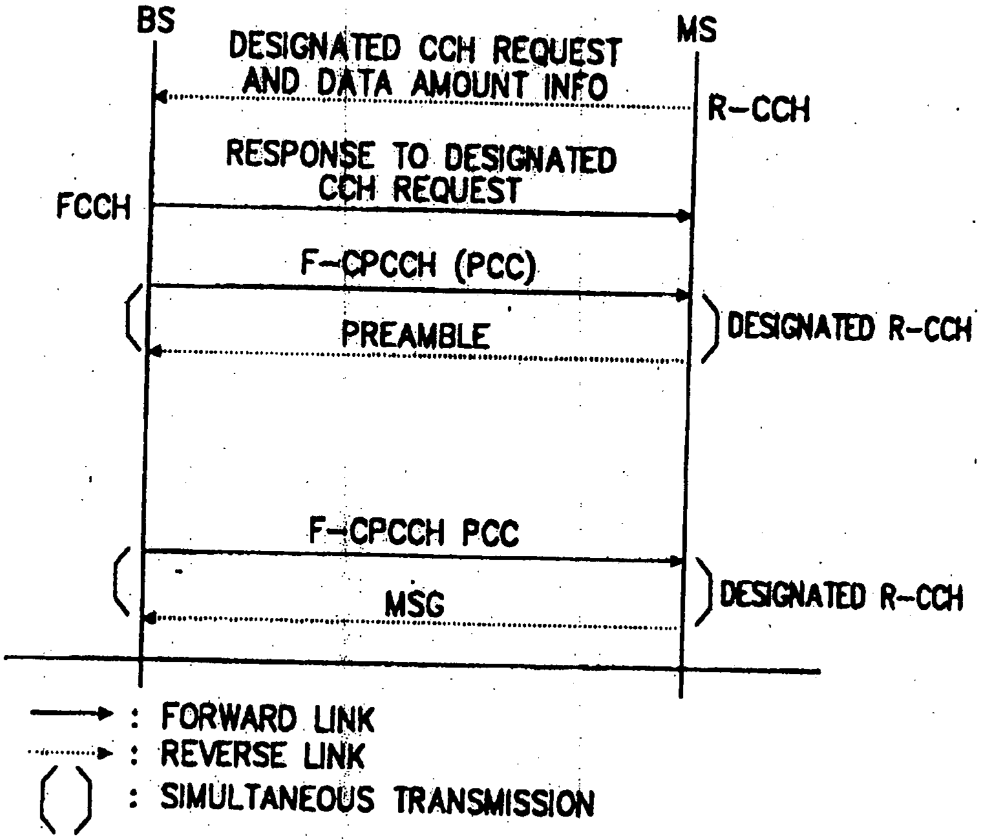

BS
MS
DESIGNATED CCH REQUEST AND DATA AMOUNT INFO
R-CCH
RESPONSE TO DESIGNATED CCH REQUEST
FCCH
F-CPCCH (PCC)
PREAMBLE
DESIGNATED R-CCH
F-CPCCH PCC
MSG
DESIGNATED R-CCH
: FORWARD LINK
: REVERSE LINK
: SIMULTANEOUS TRANSMISSION

FIG. 2

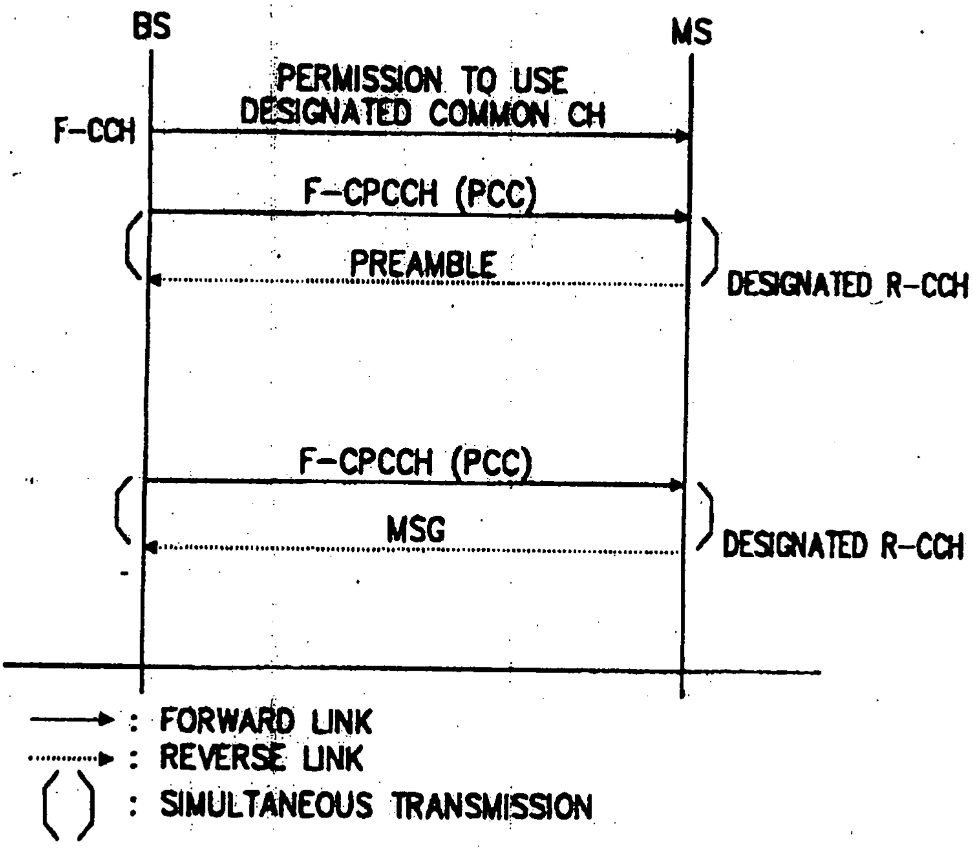

BS
MS
PERMISSION TO USE DESIGNATED COMMON CH
F-CCH
F-CPCCH (PCC)
PREAMBLE
DESIGNATED R-CCH
F-CPCCH (PCC)
MSG
DESIGNATED R-CCH
: FORWARD LINK
: REVERSE LINK
: SIMULTANEOUS TRANSMISSION

FIG. 3

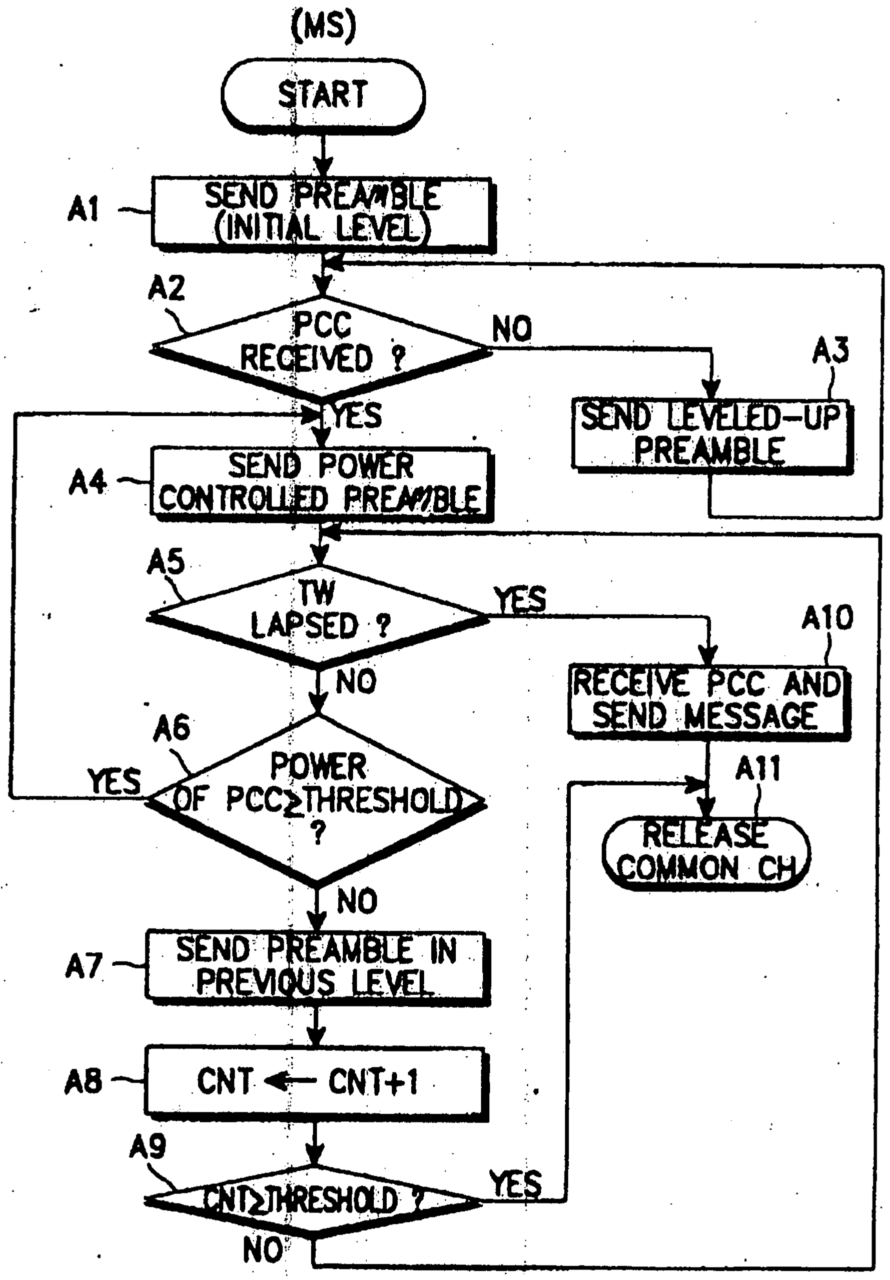

(MS)
START
A1
SEND PREAMBLE (INITIAL LEVEL)
A2
PCC RECEIVED ?
NO
A3
SEND LEVELED-UP PREAMBLE
YES
A4
SEND POWER CONTROLLED PREAMBLE
A5
TW LAPSED ?
YES
A10
RECEIVE PCC AND SEND MESSAGE
NO
A6
POWER OF PCC≥THRESHOLD ?
YES
A11
RELEASE COMMON CH
NO
A7
SEND PREAMBLE IN PREVIOUS LEVEL
A8
CNT ← CNT+1
A9
CNT≥THRESHOLD ?
YES
NO

FIG. 4

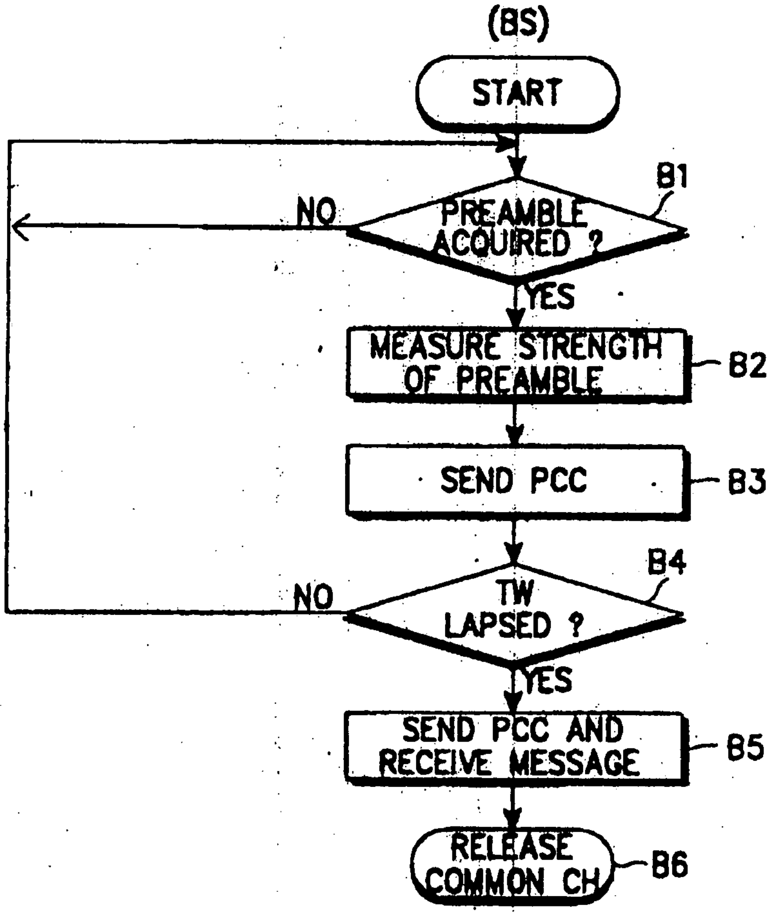
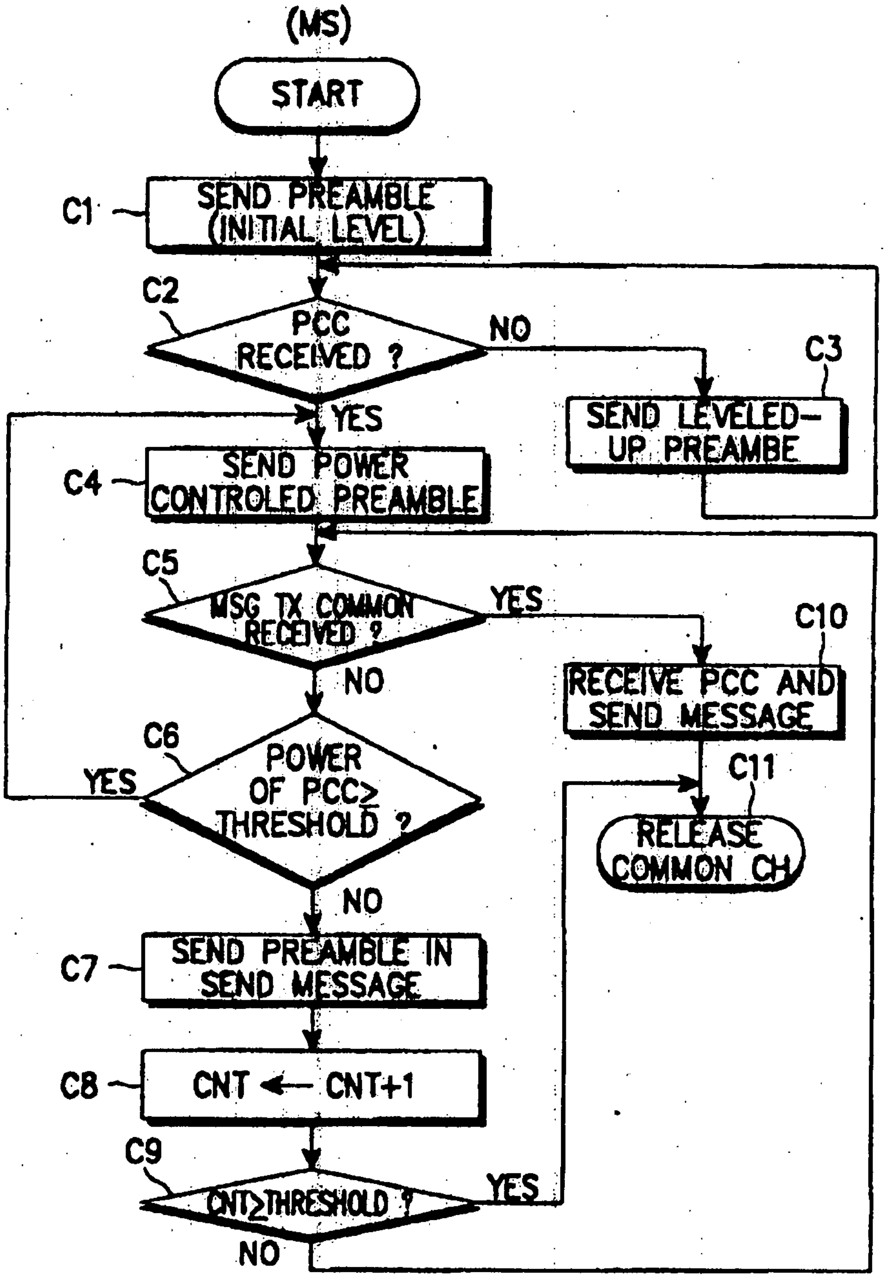

(BS)
START
B1
PREAMBLE ACQUIRED ?
NO
YES
MEASURE STRENGTH OF PREAMBLE
B2
SEND PCC
B3
B4
TW LAPSED ?
NO
YES
SEND PCC AND RECEIVE MESSAGE
B5
RELEASE COMMON CH
B6

FIG. 5



(MS)
START
C1
SEND PREAMBLE (INITIAL LEVEL)
C2
PCC RECEIVED ?
NO
C3
SEND LEVELED-UP PREAMBE
YES
C4
SEND POWER CONTROLED PREAMBLE
C5
MSG TX COMMON RECEIVED ?
YES
C10
RECEIVE PCC AND SEND MESSAGE
NO
C6
POWER OF PCC≥ THRESHOLD ?
YES
C11
RELEASE COMMON CH
NO
C7
SEND PREAMBLE IN SEND MESSAGE
C8
CNT ← CNT+1
C9
CNT≥THRESHOLD ?
YES
NO

FIG. 6

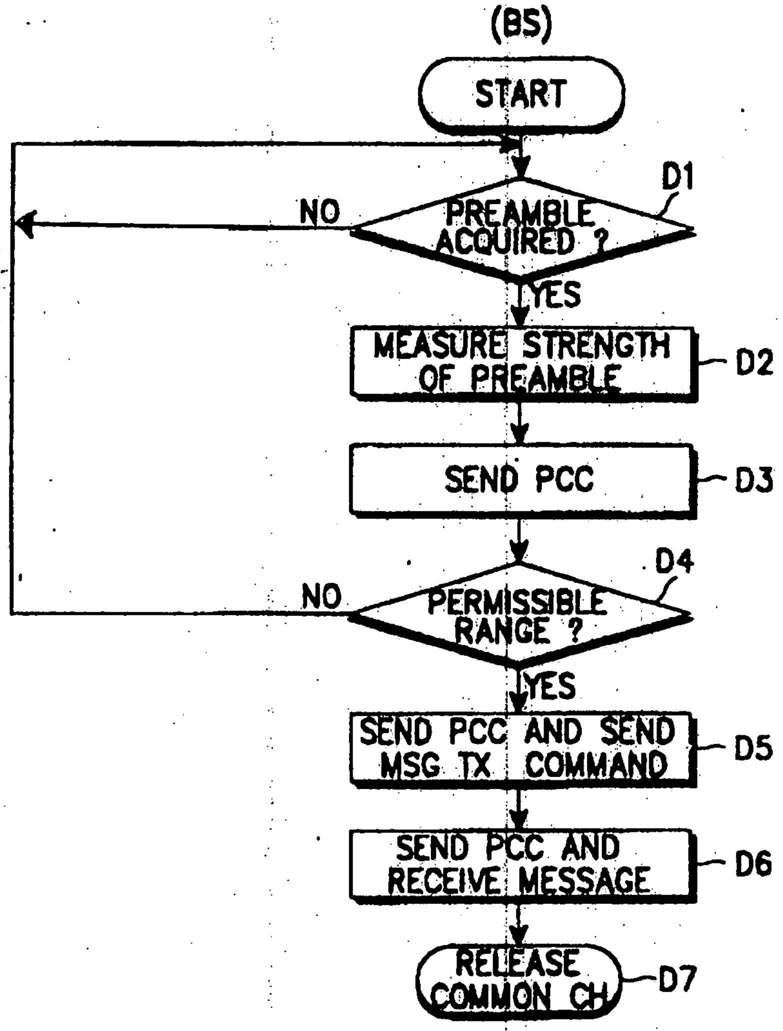

(BS)
START
PREAMBLE ACQUIRED ?
D1
NO
YES
MEASURE STRENGTH OF PREAMBLE
D2
SEND PCC
D3
PERMISSIBLE RANGE ?
D4
NO
YES
SEND PCC AND SEND MSG TX COMMAND
D5
SEND PCC AND RECEIVE MESSAGE
D6
RELEASE COMMON CH
D7

FIG. 7

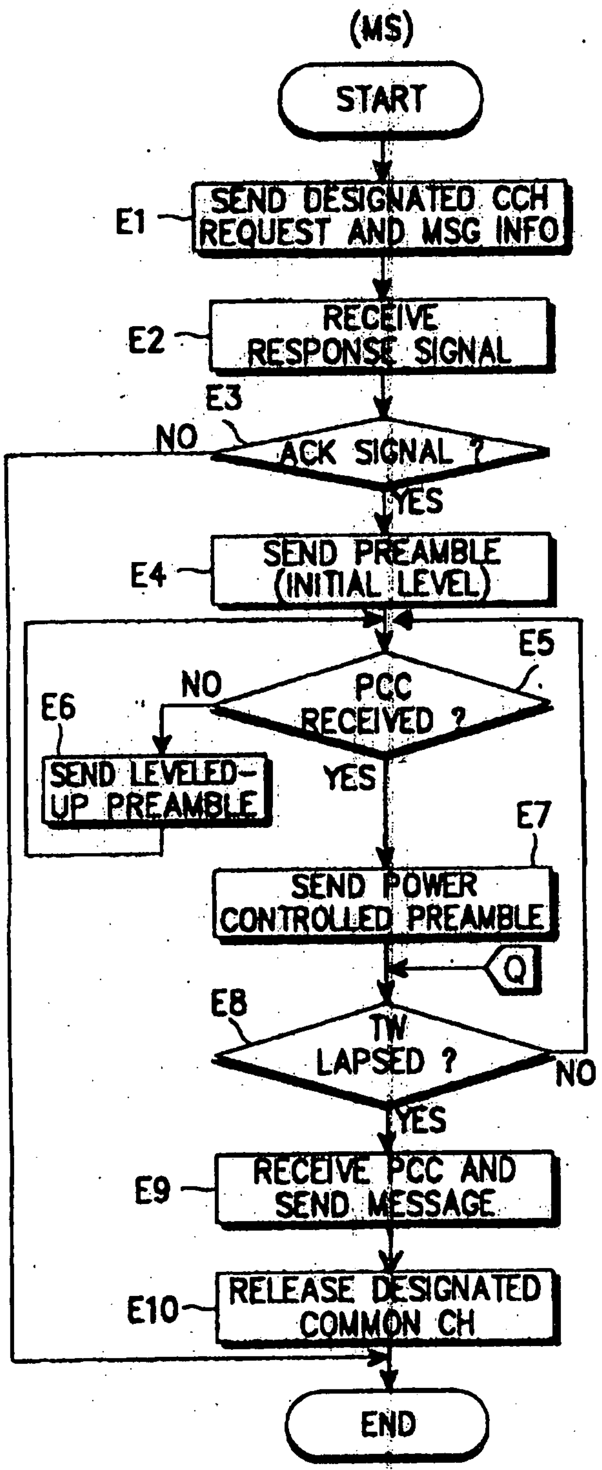

(MS)
START
E1
SEND DESIGNATED CCH REQUEST AND MSG INFO
E2
RECEIVE RESPONSE SIGNAL
E3
ACK SIGNAL ?
NO
YES
E4
SEND PREAMBLE (INITIAL LEVEL)
E5
PCC RECEIVED ?
NO
YES
E6
SEND LEVELED-UP PREAMBLE
E7
SEND POWER CONTROLLED PREAMBLE
Q
E8
TW LAPSED ?
NO
YES
E9
RECEIVE PCC AND SEND MESSAGE
E10
RELEASE DESIGNATED COMMON CH
END

FIG. 8

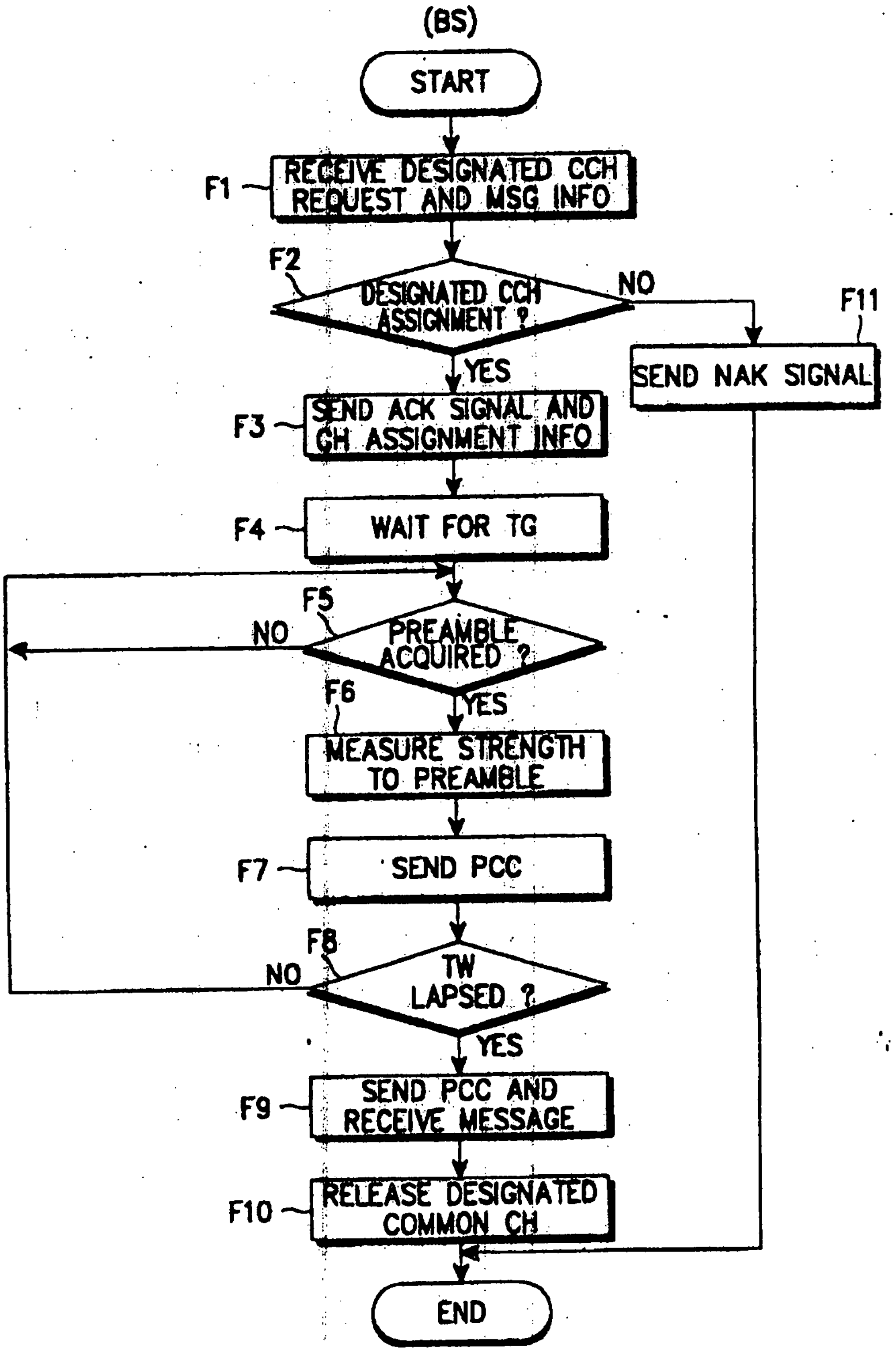
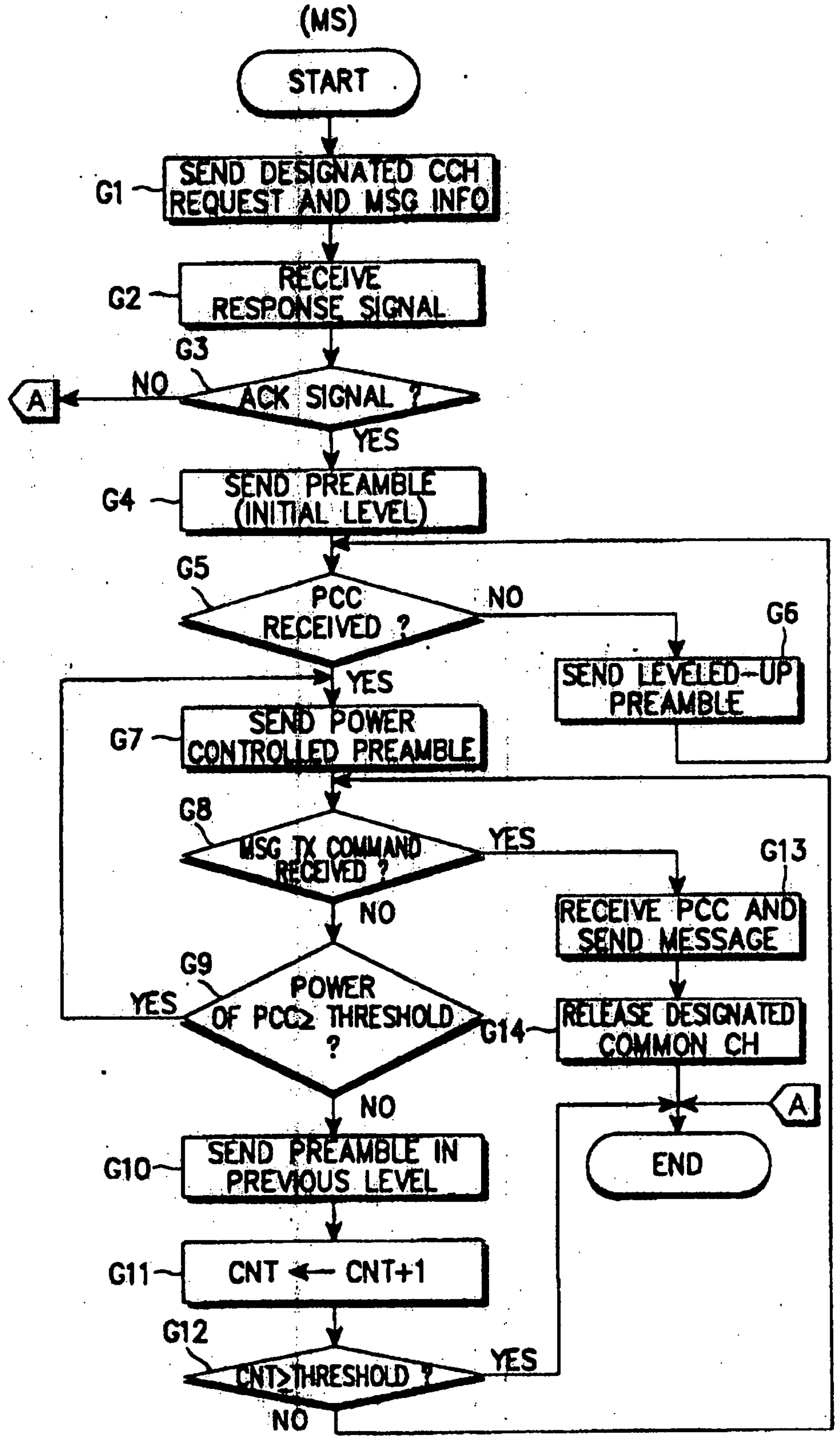

(BS)
START
F1
RECEIVE DESIGNATED CCH REQUEST AND MSG INFO
F2
DESIGNATED CCH ASSIGNMENT ?
NO
YES
F11
SEND NAK SIGNAL
F3
SEND ACK SIGNAL AND CH ASSIGNMENT INFO
F4
WAIT FOR TG
F5
PREAMBLE ACQUIRED ?
NO
YES
F6
MEASURE STRENGTH TO PREAMBLE
F7
SEND PCC
F8
TW LAPSED ?
NO
YES
F9
SEND PCC AND RECEIVE MESSAGE
F10
RELEASE DESIGNATED COMMON CH
END

FIG. 9



(MS)
START
G1
SEND DESIGNATED CCH REQUEST AND MSG INFO
G2
RECEIVE RESPONSE SIGNAL
G3
ACK SIGNAL ?
NO
A
YES
G4
SEND PREAMBLE (INITIAL LEVEL)
G5
PCC RECEIVED ?
NO
G6
SEND LEVELED-UP PREAMBLE
YES
G7
SEND POWER CONTROLLED PREAMBLE
G8
MSG TX COMMAND RECEIVED ?
YES
G13
RECEIVE PCC AND SEND MESSAGE
NO
G9
POWER OF PCC≥ THRESHOLD ?
YES
G14
RELEASE DESIGNATED COMMON CH
NO
A
END
G10
SEND PREAMBLE IN PREVIOUS LEVEL
G11
CNT ← CNT+1
G12
CNT≥THRESHOLD ?
YES
NO

FIG. 10

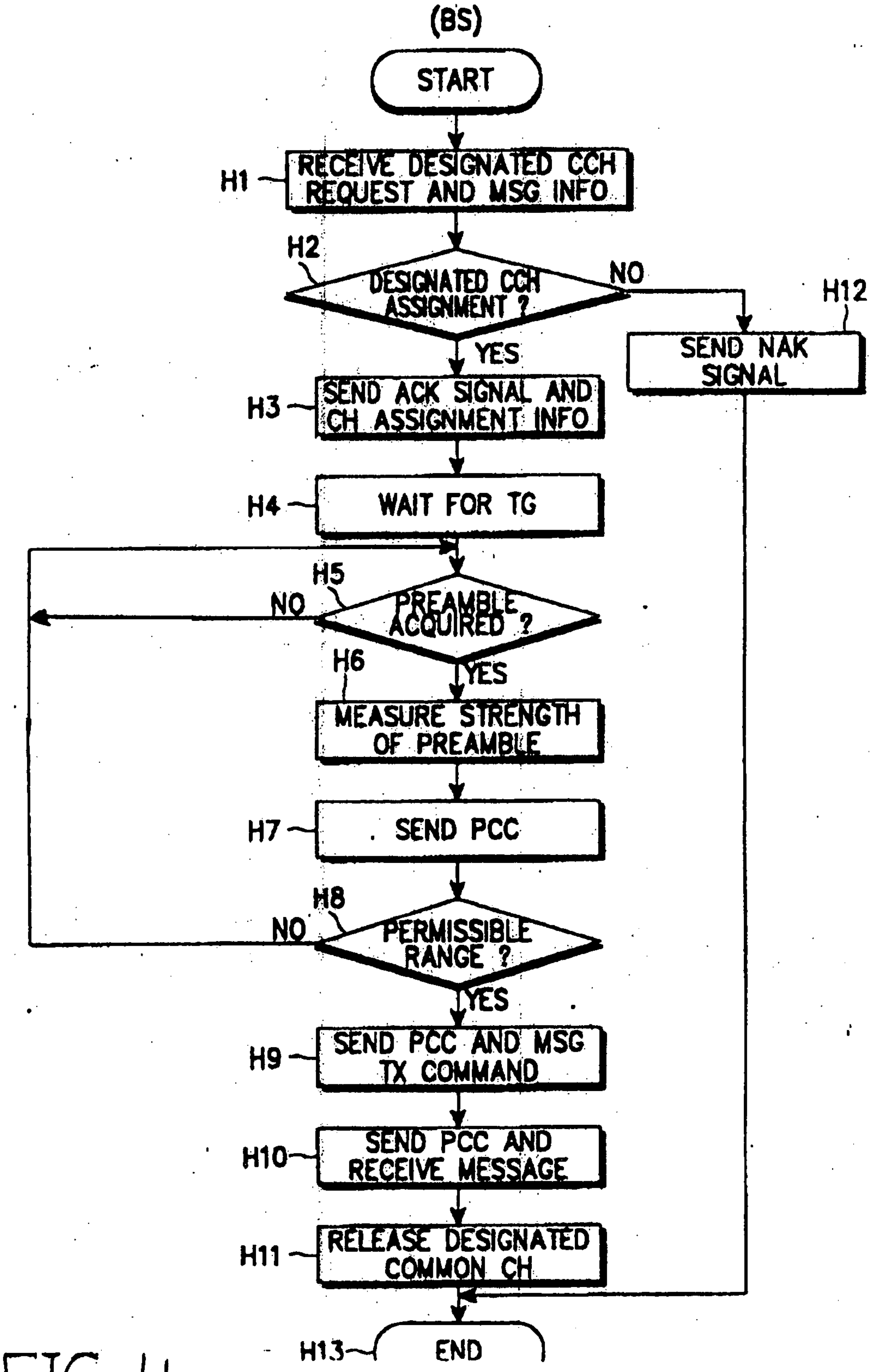

(BS)
START
H1
RECEIVE DESIGNATED CCH REQUEST AND MSG INFO
H2
DESIGNATED CCH ASSIGNMENT ?
NO
H12
SEND NAK SIGNAL
YES
H3
SEND ACK SIGNAL AND CH ASSIGNMENT INFO
H4
WAIT FOR TG
H5
PREAMBLE ACQUIRED ?
NO
YES
H6
MEASURE STRENGTH OF PREAMBLE
H7
SEND PCC
H8
PERMISSIBLE RANGE ?
NO
YES
H9
SEND PCC AND MSG TX COMMAND
H10
SEND PCC AND RECEIVE MESSAGE
H11
RELEASE DESIGNATED COMMON CH
H13
END

FIG. 11

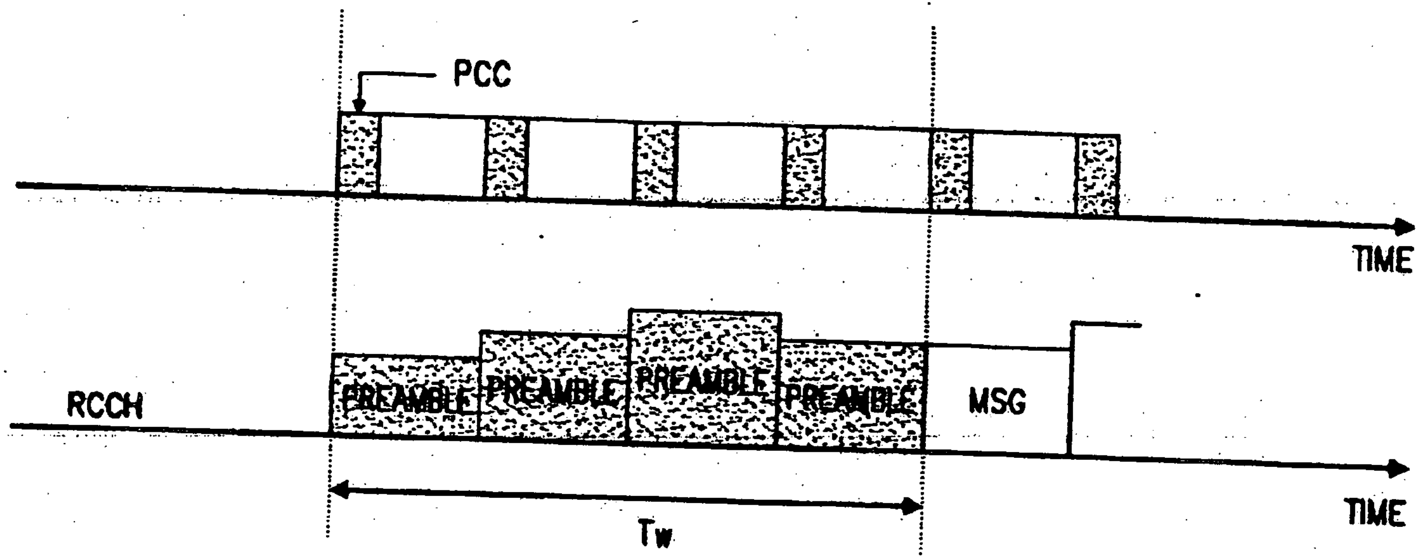

PCC
TIME
RCCH
PREAMBLE
PREAMBLE
PREAMBLE
PREAMBLE
MSG
Tw
TIME

FIG. 12

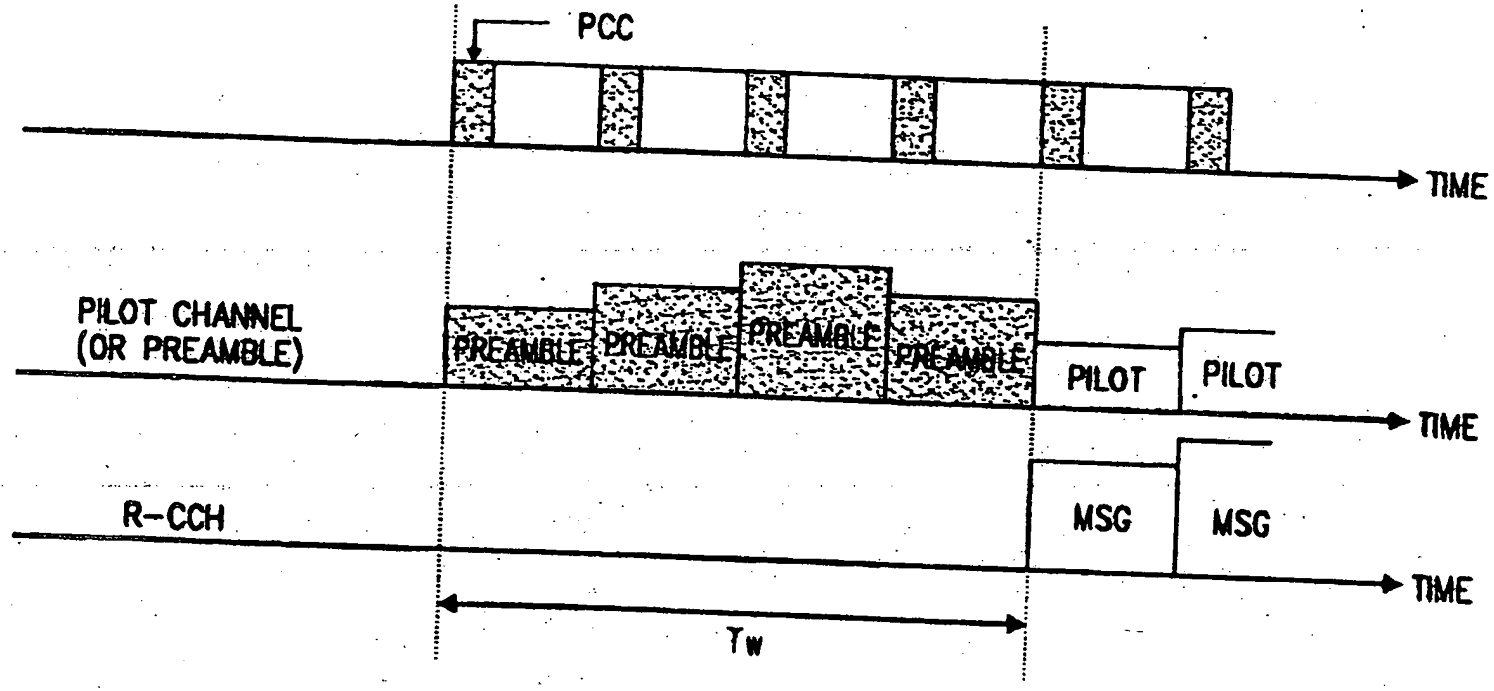

PCC
TIME
PILOT CHANNEL
(OR PREAMBLE)
PREAMBLE
PREAMBLE
PREAMBLE
PREAMBLE
PILOT
PILOT
TIME
R-CCH
MSG
MSG
TIME
Tw

FIG. 13

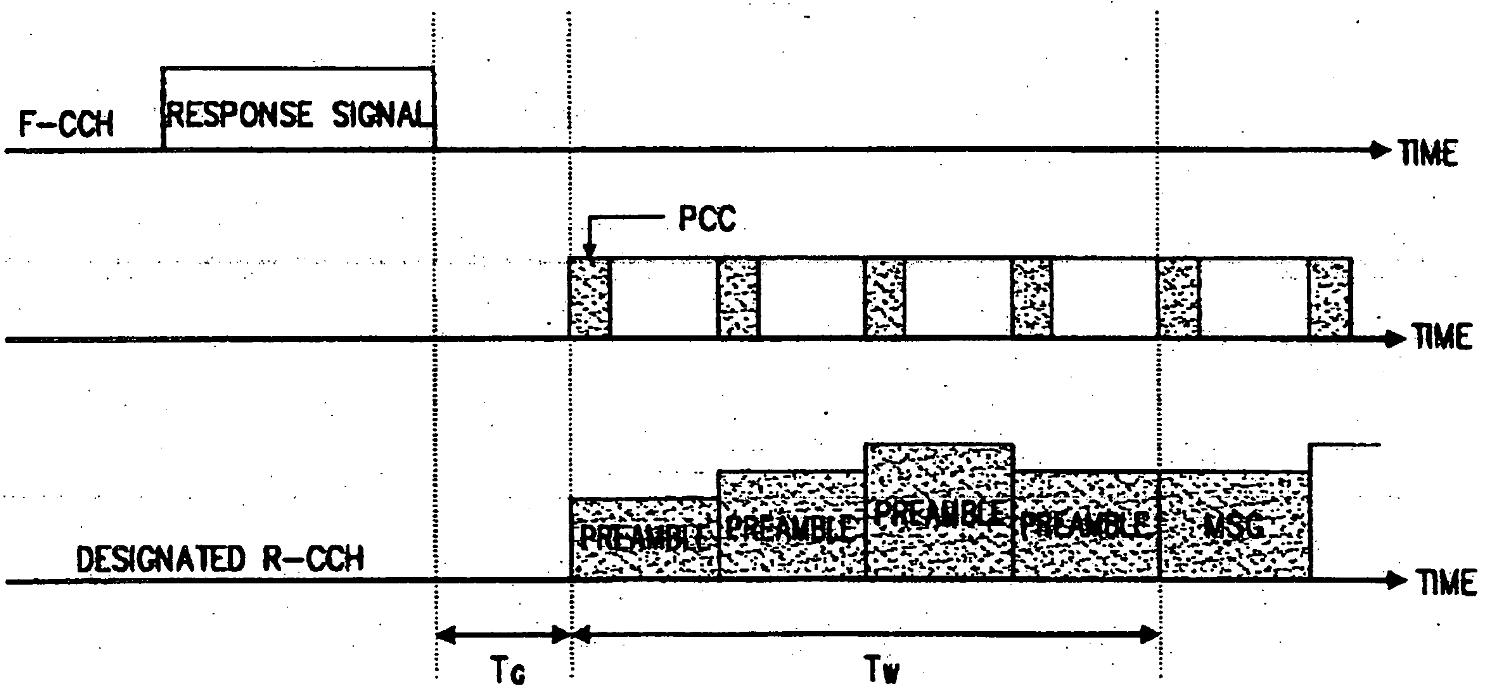

F-CCH
RESPONSE SIGNAL
TIME
PCC
TIME
DESIGNATED R-CCH
PREAMBLE
PREAMBLE
PREAMBLE
PREAMBLE
MSG
TIME
Tc
Tw

FIG. 14

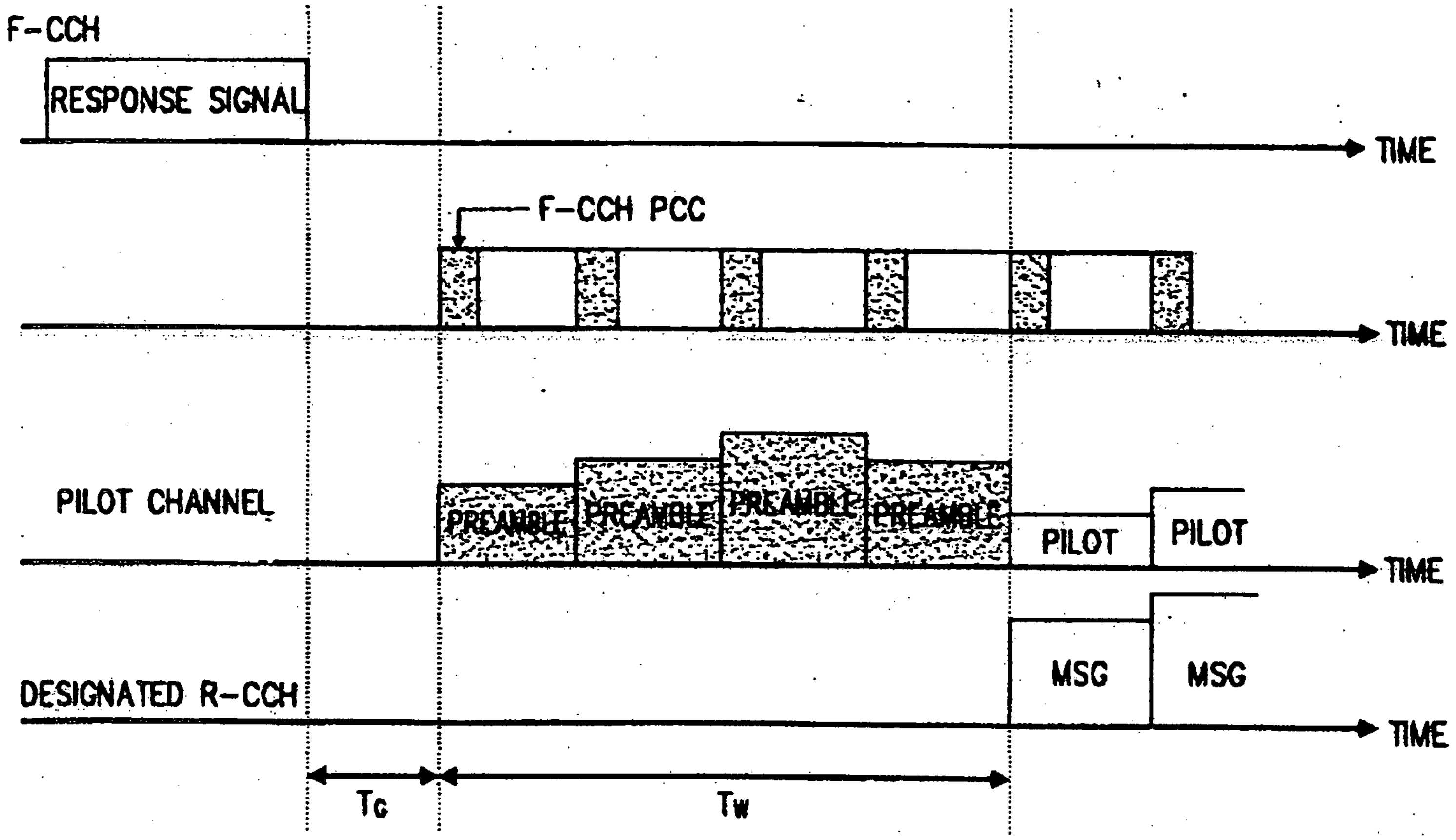

F-CCH
RESPONSE SIGNAL
TIME
F-CCH PCC
TIME
PILOT CHANNEL
PREAMBLE
PREAMBLE
PREAMBLE
PREAMBLE
PILOT
PILOT
TIME
DESIGNATED R-CCH
MSG
MSG
TIME
TG
TW

FIG. 15

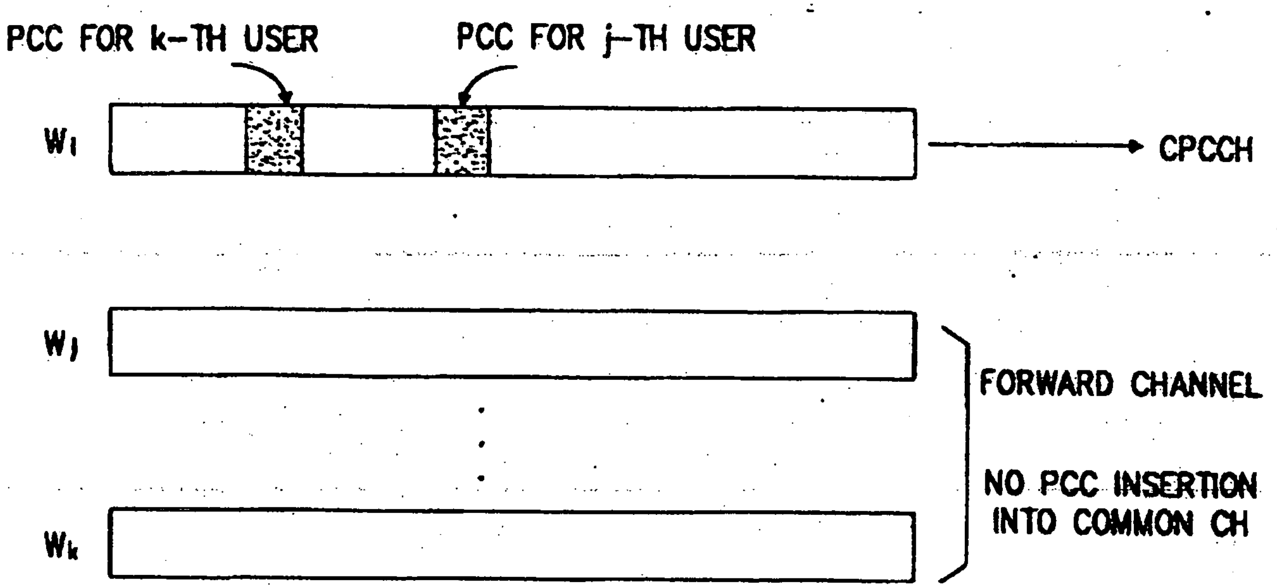

PCC FOR k–TH USER
PCC FOR j–TH USER
W_1
CPCCH
W_j
W_k
FORWARD CHANNEL
NO PCC INSERTION INTO COMMON CH

FIG. 16

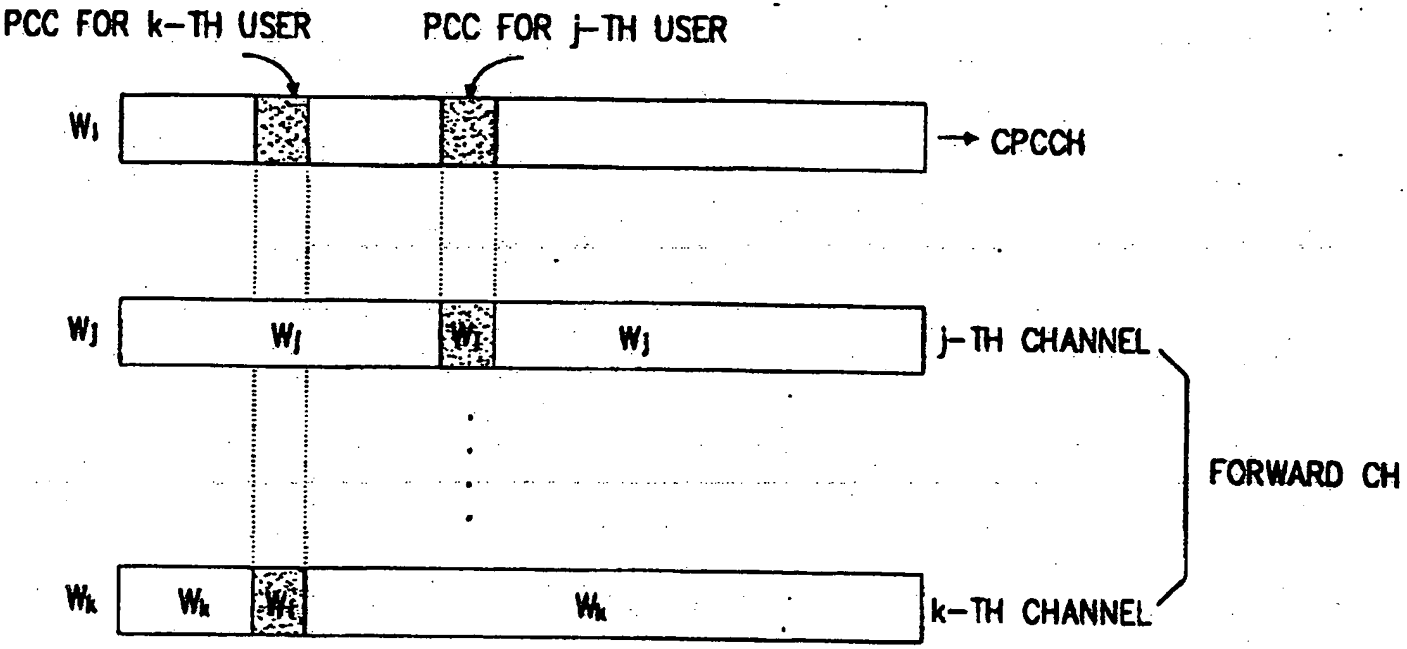

PCC FOR k-TH USER
PCC FOR j-TH USER
W_I
CPCCH
W_j
W_j
W_I
W_j
j-TH CHANNEL
FORWARD CH
W_k
W_k
W_I
W_k
k-TH CHANNEL

FIG. 17

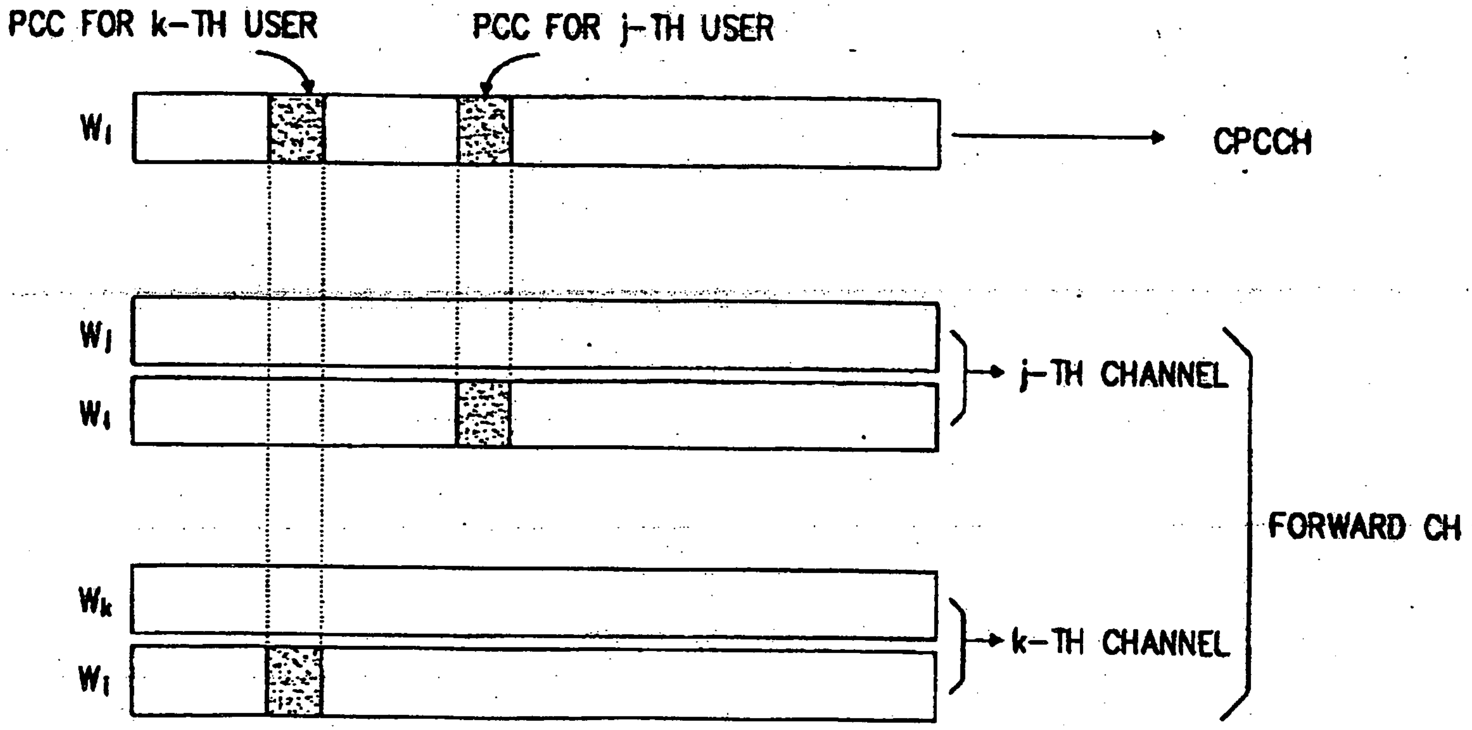

PCC FOR k-TH USER
PCC FOR j-TH USER
W_1
CPCCH
W_j
W_1
j-TH CHANNEL
FORWARD CH
W_k
W_1
k-TH CHANNEL

FIG. 18

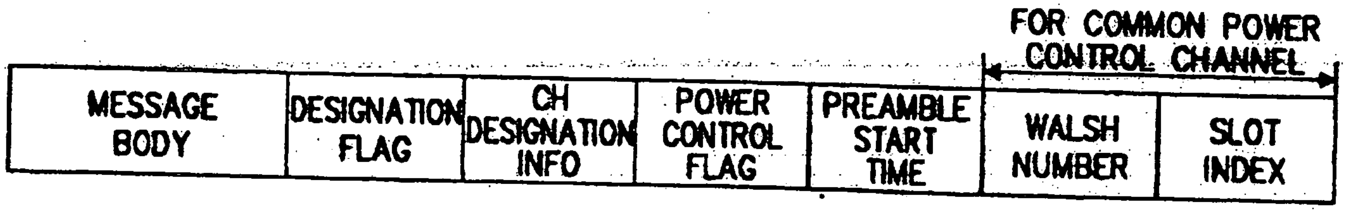

FOR COMMON POWER CONTROL CHANNEL
MESSAGE BODY
DESIGNATION FLAG
CH DESIGNATION INFO
POWER CONTROL FLAG
PREAMBLE START TIME
WALSH NUMBER
SLOT INDEX

FIG. 19

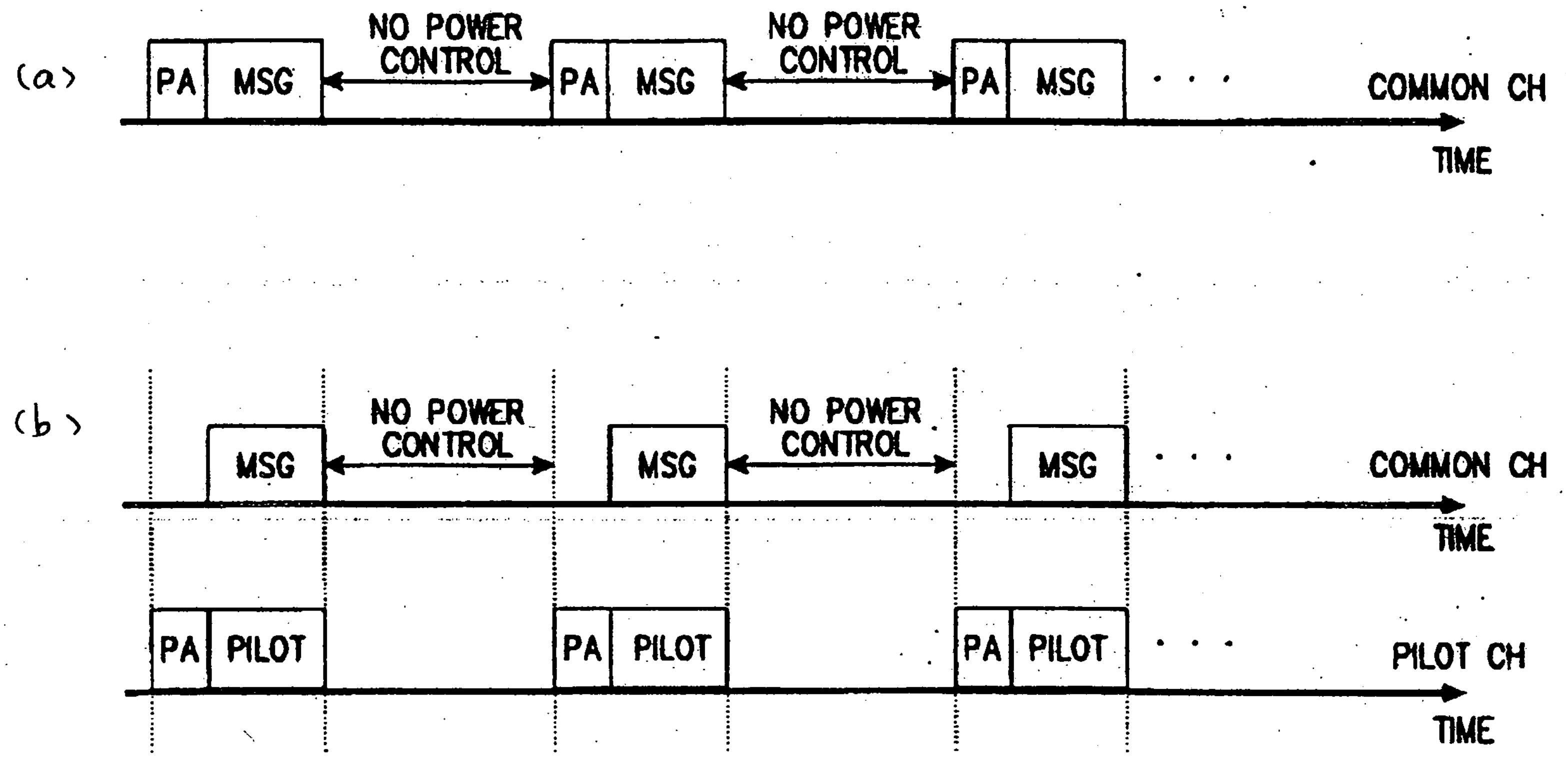

(a)
PA
MSG
NO POWER CONTROL
PA
MSG
NO POWER CONTROL
PA
MSG
COMMON CH
TIME
(b)
MSG
NO POWER CONTROL
MSG
NO POWER CONTROL
MSG
COMMON CH
TIME
PA
PILOT
PA
PILOT
PA
PILOT
PILOT CH
TIME

FIG. 20

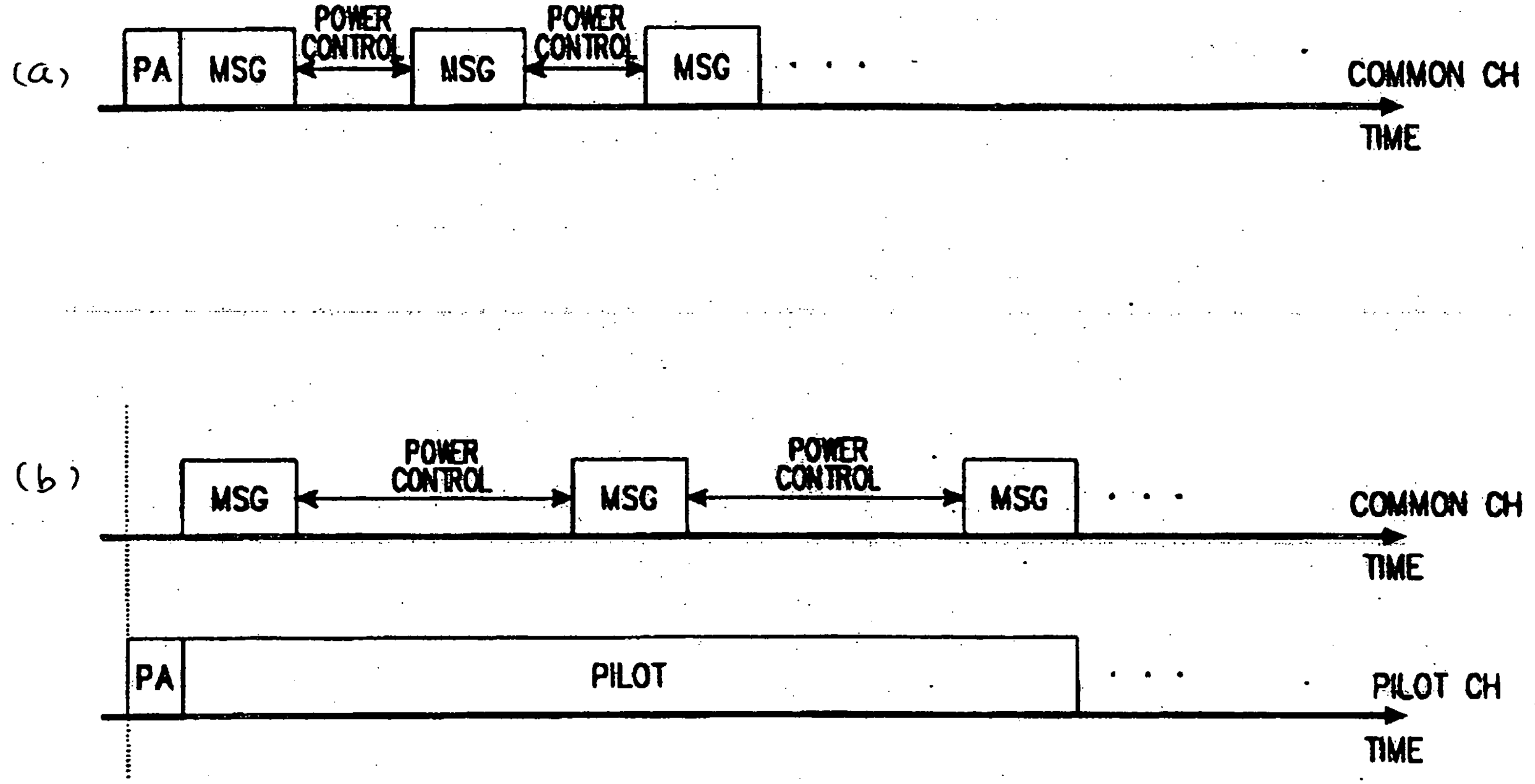

(a)
PA
MSG
POWER CONTROL
MSG
POWER CONTROL
MSG
COMMON CH
TIME
(b)
MSG
POWER CONTROL
MSG
POWER CONTROL
MSG
COMMON CH
TIME
PA
PILOT
PILOT CH
TIME

FIG. 21

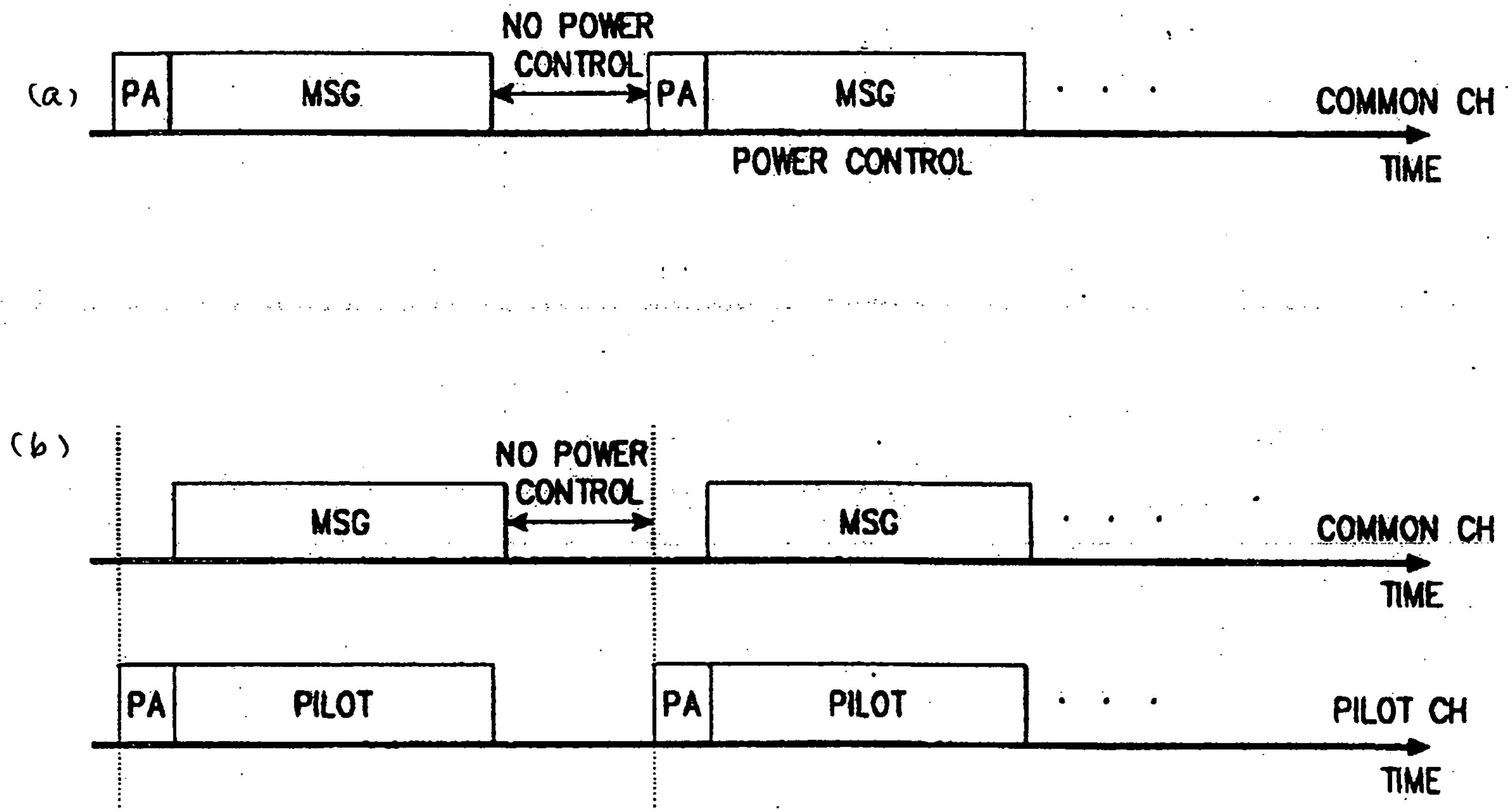

(a)
PA
MSG
NO POWER CONTROL
PA
MSG
POWER CONTROL
COMMON CH
TIME
(b)
MSG
NO POWER CONTROL
MSG
COMMON CH
TIME
PA
PILOT
PA
PILOT
PILOT CH
TIME

FIG. 22

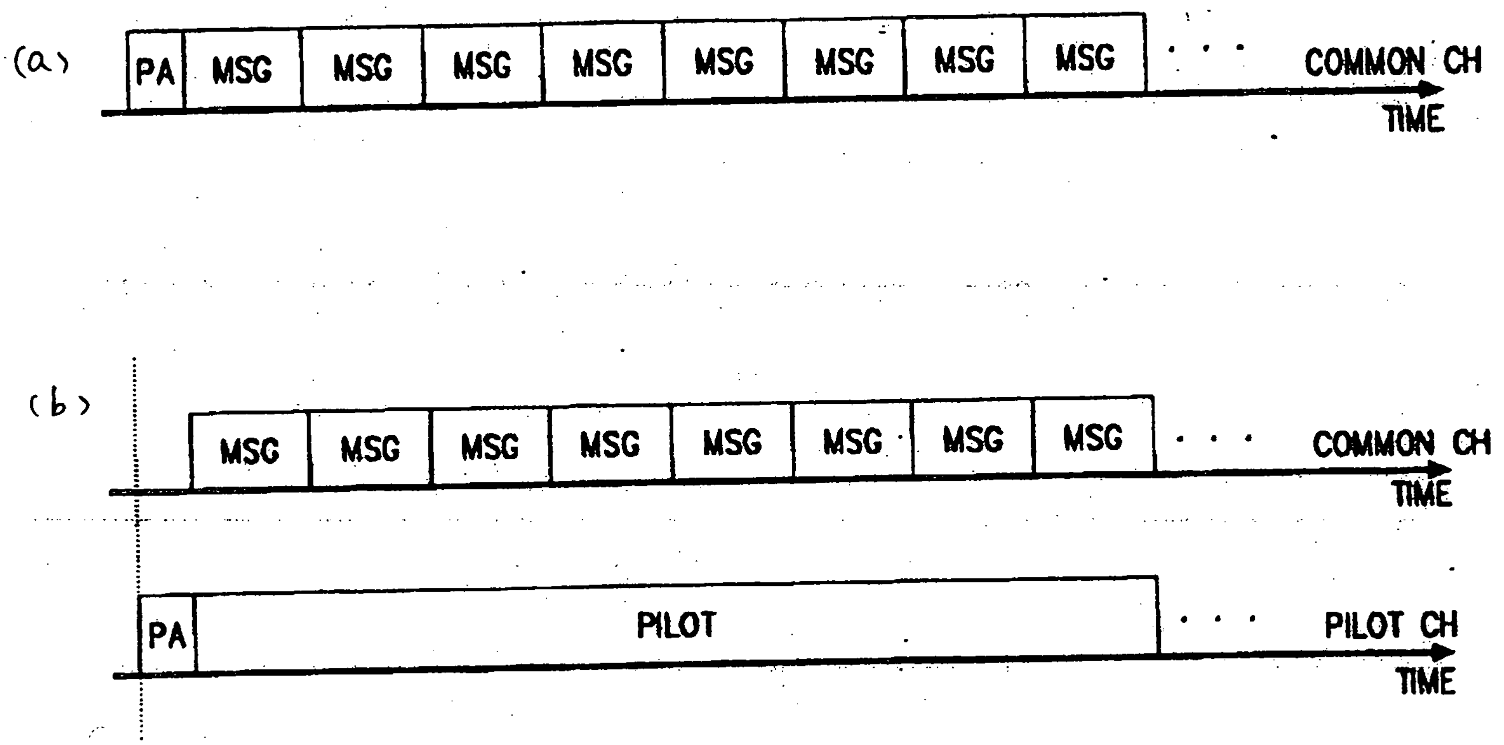

(a)
PA
MSG
MSG
MSG
MSG
MSG
MSG
MSG
MSG
COMMON CH
TIME
(b)
MSG
MSG
MSG
MSG
MSG
MSG
MSG
MSG
COMMON CH
TIME
PA
PILOT
PILOT CH
TIME

FIG. 23